Engineering Library

MAR 5 1937

# INDUSTRIAL ENGINEERING

## MAINTENANCE ENGINEERING
### IN PLANTS, MILLS, AND FACTORIES

A McGraw-Hill Publication
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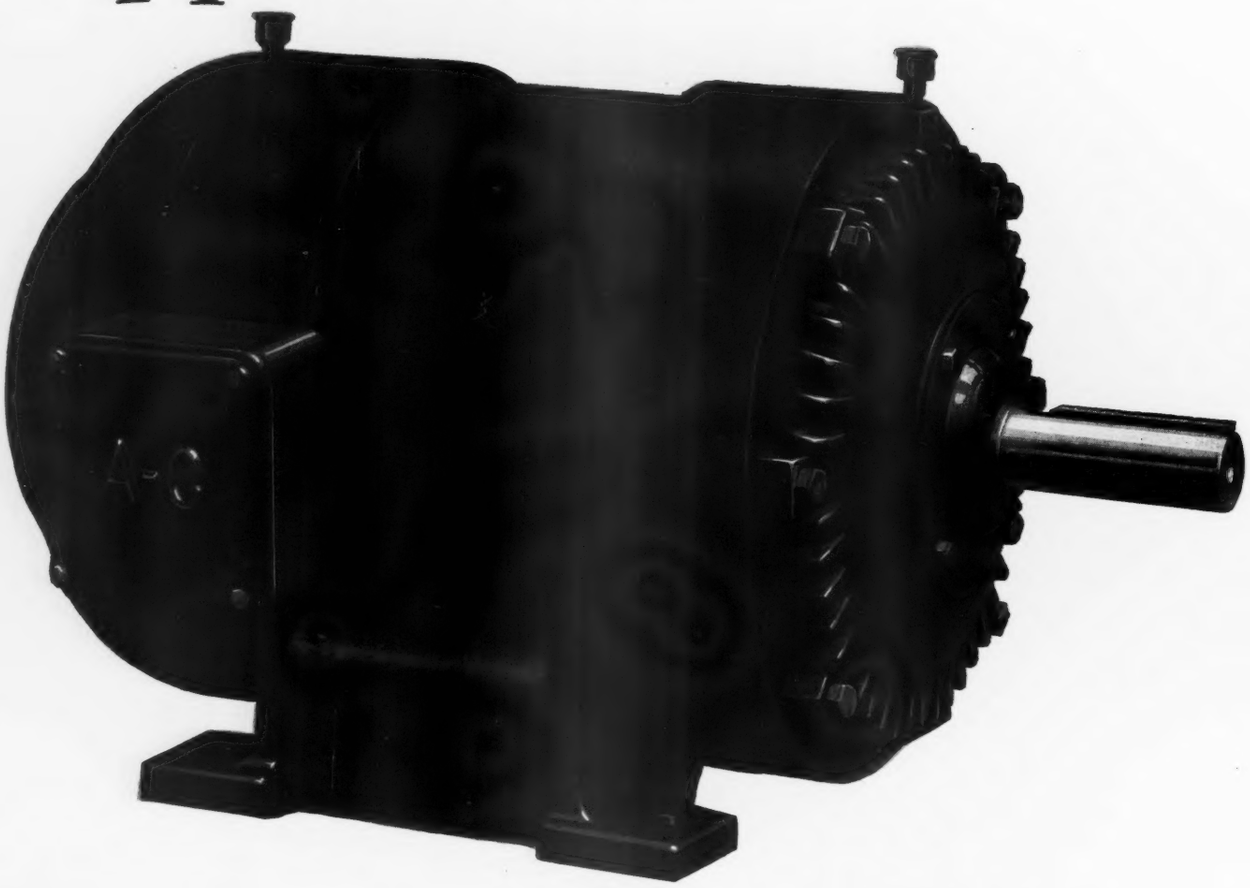
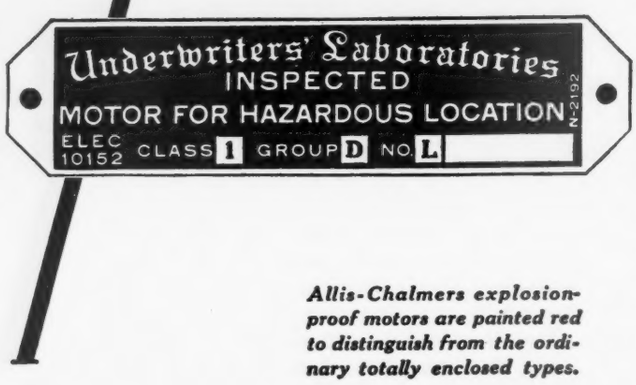
MARCH - 1931

For cover story
see page 142

# *Approved—*



# *Explosion Proof Motor*




***Allis-Chalmers explosion-proof motors are painted red to distinguish from the ordinary totally enclosed types.***

**Allis-Chalmers Manufacturing Company takes pleasure in announcing approval, by the Underwriters' Laboratories, of its line of explosion-proof motors. These have been tested and approved for Class 1, Group D Locations, Gasoline (Pyroxylin Lacquer Vapor) and each motor carries the Underwriters' label for this service.**

**With more than four years of experience in the manufacture of the compact and efficient, enclosed, fan-cooled motor, a design was developed for the Allis-Chalmers explosion-proof motor which is not encumbered with excess weight, bulkiness, and without sacrifice of accessibility.**

***Send for descriptive leaflet 2125.***

# ALLIS-CHALMERS

**Allis-Chalmers Manufacturing Company, Milwaukee**

INDUSTRIAL ENGINEERING

A McGraw-Hill Publication, founded 1882

MARCH, 1931

# LUBRICATION ENGINEERING

## as practiced in our 18 plants

By H. V. WALLACE

*Lubrication Engineer, Owens-Illinois Glass Company*
*Toledo, Ohio*

INDUSTRY constantly is faced with the necessity of eliminating and preventing waste. Recognizing that power and maintenance represent large items of expense in the manufacture of glassware the Owens-Illinois Glass Company, Toledo, Ohio, concluded that a considerable portion of this expense could be prevented by providing correct lubrication for all equipment.

It was believed that a lubrication engineer could reduce this item by more than enough to pay his salary by making a constant study of the influence of lubrication on power, repairs, maintenance, depreciation, insurance, production and labor. The first steps were to determine what kinds of lubricants to use, how to apply them, and how to control this application.

Having plants in widely separated parts of the country, we were buying oils from several companies. The brand name of one company for a given class of service, air-compressor oil for example, differed from the brand name of another company. It was, therefore, difficult to get a composite picture of our entire problem on the basis of brand names.

We prepared a set of specifications covering our entire requirements, using the physical characteristics of lubricants which we knew to be correct. We gave each of these specifications a number and then classified

**SIX STEPS**
**that eliminated waste and cut maintenance**

1. Uniform lubricant specifications for all similar types of equipment in all plants

2. Standardized instructions for the application and use of lubricants

3. The establishment of a central lubricant dispensary in each plant

4. Daily distribution and consumption records. These reports spotted trouble immediately and reduced the number of breakdowns

5. The use of mechanical lubricating devices wherever possible, with subsequent reduction in labor costs

6. Oilers designated in each plant to be directly responsible for the equipment under their care

the various brands in use in accordance with our new specification numbers, eliminating as many brands in each plant as possible.

Next, we arranged with our suppliers to stencil our specification number on all incoming containers. We were then ready to keep plant records which could be assembled into a report covering all plants. The forms shown illustrate how daily and monthly records are kept.

To provide a temporary guide, a survey of each plant was made showing the equipment by departments. The survey shows the parts on each machine to be lubricated, how lubricant should be applied to each part and the proper lubricant to use, designated by our own specification number. In this way each department head is given a complete picture of his lubrication requirements.

The plant engineer in each plant was made responsible for the entire lubrication of the plant. In most industrial plants each department foreman works out his lubrication problems and often he is forced to do this with a very meager knowledge of the fundamentals involved. We sought to establish in each plant a definite authority on lubrication problems, who would ultimately become sufficiently educated in the fundamentals that all such problems would receive intelligent consideration.

Each plant engineer has in his department one man who is charged with seeing that the details of the recommendations in the survey are carried out. This individual is responsible to the plant engineer for the general lubrication conditions in the plant. The procedure which he follows is to make an inspection of all departments once each week, making a report to the plant engineer showing the progress that is being made and how it is maintained. He checks on the installation of automatic devices, their maintenance, the routine of filling, conditions of oil house, and so on, pointing out where waste is taking place or ineffective results are being experienced. In cases where improvement is recommended, the plant engineer takes the matter up with the head of the department in question and arranges the necessary steps.

A central lubricant dispensary was established in each plant. In the smaller plants lubricants are dispensed only at certain hours, in other plants they are obtainable 24 hours per day. It is relatively easy to determine that quantities varying from one quart to ten gallons of a given lubricant are consumed in the various departments daily, and to set up distribution points. These points of distribution will not exceed fifteen in a very large factory. Therefore, it was thought wasteful to have a number of individuals making many trips per day to the stores for small quantities of lubricants, usually only enough for a shift, when one member of the oiling crew could do the entire job in less than one hour's time.

Daily distribution and records were decided upon in order to detect at once any troubles which might occur. A sudden increase or decrease in consumption indicates that something has probably happened which should

Form 1166

**DAILY DELIVERIES OF LUBRICANTS**

Lubricating Oils Shown in Gallons.
Grease Shown in Pounds. Date

| Specification | #1 | #2 | #3 | #4 | #5 | #6 | #7 | #8 | #9 | #10 | #11 | #12 | #13 | #14 | #15 | #16 | #17 |
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| Forming Dept. | | | | | | | | | | | | | | | | | |
| Batch Pl. | | | | | | | | | | | | | | | | | |
| Prod. Pl. | | | | | | | | | | | | | | | | | |
| Power Pl. | | | | | | | | | | | | | | | | | |
| Electrical Dept. | | | | | | | | | | | | | | | | | |
| Box Pl. | | | | | | | | | | | | | | | | | |
| Mold Shop | | | | | | | | | | | | | | | | | |
| Corr. Plant | | | | | | | | | | | | | | | | | |
| Auto. Dept. | | | | | | | | | | | | | | | | | |
| TOTAL | | | | | | | | | | | | | | | | | |

**Form on which records of the lubricants supplied daily are obtained. Each type of lubricant is specified by number.**

**All plants contribute information monthly on the total quantity of lubricants used. Deviations from the normal supply are checked to determine the causes.**

Form 1167

PLANT NO.
OILS: SHOWN IN GALLONS.
GREASE: SHOWN IN POUNDS.

**MONTHLY LU**

| YEAR | FORMING DEPARTMENT Lubricants Used | | | | | | | | | | | | | | | | BATCH PLANT Lubricants Used | | | | | | PRODUCER PLANT Lubricants Used | | | | | | | | | |
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| MONTH | SPEC. No. | | SPEC. No. | | SPEC. No. | | SPEC. No. | | SPEC. No. | | SPEC. No. | | SPEC. No. | | SPEC. No. | | SPEC. No. | | SPEC. No. | | SPEC. No. | | SPEC. No. | | SPEC. No. | | SPEC. No. | | SPEC. No. | | SPEC. No. | |
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| 31 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

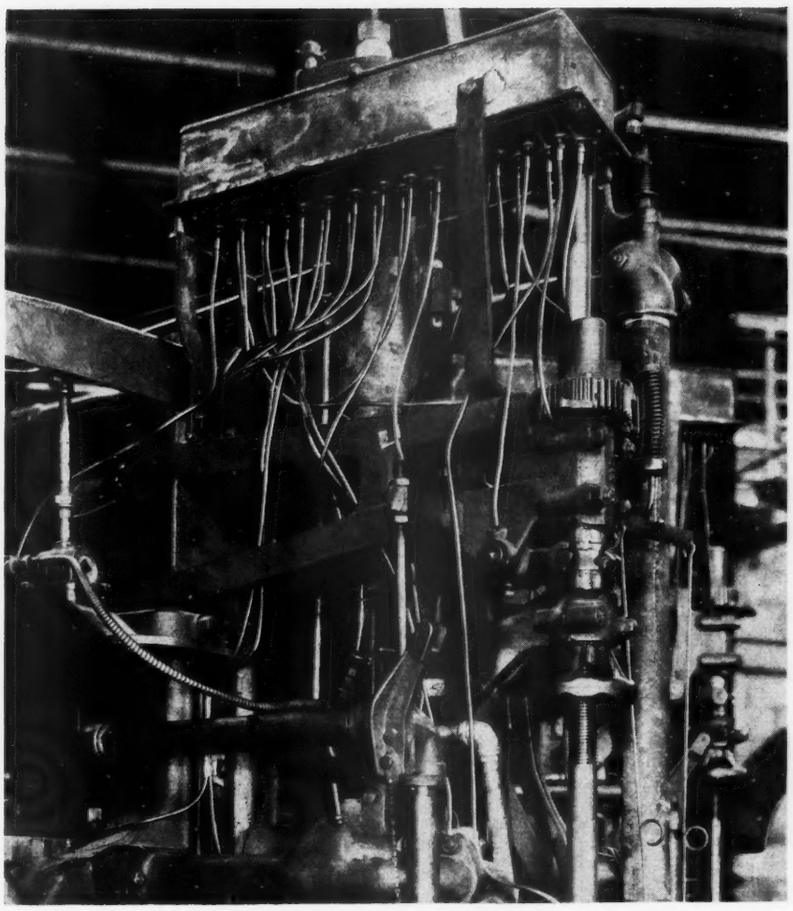
be corrected. It is thus brought to the attention of the plant engineer, who can take it up with the department head. In many instances this procedure has prevented expensive interruptions to production.

In some factories we had oilers on duty in shifts, whereas in other factories a great deal of oiling was done by individuals other than regular oilers. We decided that all oiling except that required for electric motors and power equipment should be done by regular oilers. Only in that way could we control the expense of oiling labor.

It was found that oiling labor expense, as well as the effectiveness of lubrication, was largely dependent on the method of application, assuming that the correct lubricant had been selected. With this in mind we decided that hand oiling should be eliminated to the greatest possible extent.

We found that practically all of our problems could be handled with one of four kinds of devices: mechanical force feed where a lubricant was to be applied against pressure or circulated; bottle oilers for bearings requiring an extremely small quantity of lubricant; screw-down grease cups where grease was not applied by pressure guns; some form of wick-feed oiler for all other bearings.

The wick-feed oiler is used more extensively than any other device because of the wide range of conditions which it will meet. It can be installed directly on the bearing or in a remote location above the bearing. It permits adjustment of feed from a very small quantity to a copious supply, depending on the number of strands of yarn used. It can be used under a wide range of temperature conditions when the proper lubricant is selected. The most serious objection to it is the necessity for removing the wicks when a machine is to be idle for a long time.



**A wick oil feeder serving inaccesible points of application on an Owens bottle machine.**

Many of our machines have a great number of points of application. The greater the number of devices there are to be filled on a machine, and the more inaccessible they are, the more likely they are to be neglected, thus causing wear, power waste, and interruptions to production. We were influenced toward the wick oiler made up with multiple feeds. One of these installations is illustrated to show how inaccessible oiling points

## BRICANT REPORT

| POWER PLANT | | | | | | | | ELECTRICAL DEPT. | | | | BOX PLANT | | | | MOLD SHOP | | | | | | CORRUGATING PLANT | | | | | | | | AUTOMOTIVE DEPT. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lubricants Used | | | | | | | | Lubricants Used | | | | Lubricants Used | | | | Lubricants Used | | | | | | Lubricants Used | | | | | | | | Lubricants Used | | | | | |
| SPEC. No. | | SPEC. No. | | SPEC. No. | | SPEC. No. | | SPEC. No. | | SPEC. No. | | SPEC. No. | | SPEC. No. | | SPEC. No. | | SPEC. No. | | | | SPEC. No. | | SPEC. No. | | SPEC. No. | | | | SPEC. No. | | SPEC. No. | | SPEC. No. | |
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are reached on a bottle machine.

If it is desired to use more than one kind of lubricant in a single wick-feed oiler, it is necessary only to weld a partition in the reservoir or to have the reservoir cast with a partition providing the required number of feeds in each compartment.

It is comparatively simple to measure the results secured through the use of lubricant in terms of burned out bearings, rapidly worn bearings, rapidly worn gears and other similar external indications. The serious evils of poor lubrication are those that are so near the intangible that they occur from month to month and year to year without the real reason being discovered. Gears are replaced after five years that might just as well have lasted twenty years. Machines become gradually less productive in operation to the point where it is necessary to completely overhaul them at certain intervals.

When high power costs are experienced, the slight lowering of the temperature on thousands of bearings by correct lubrication will reduce friction losses enough to show more favorable power costs.

The cost of lubricants is such a small percentage of the total cost of production that its far reaching influence is often overlooked. Because it is one of the small items of expense, the selection of lubricants is frequently left to individuals in an organization who are not qualified to judge which is best for their needs. The supplier could be of great assistance in this connection if he would furnish engineering information instead of following the line of least resistance by selling the customer what he is most willing to accept because of unit price, delivery, and other factors which really do not work to the end that efficient lubrication is secured.

Good lubrication will result from sound buying of lubricants and habitual intelligent application of sound fundamentals in their use. Good or bad habits in lubrication are developed over a period of years, consequently practices and opinions of long standing are not very easily changed.

We are endeavoring to create right thinking by those concerned with lubrication. We expect to develop in our organization men who think of lubrication in its true relation to factory efficiency. These men in turn will be the means of pointing the way to still other people in our plants so that our lubrication habits will be developed along lines that can be depended upon to constantly bring about increased effectiveness. We believe that only in this way can we expect to achieve the economies that accrue from the correct lubrication of equipment.

# Misapplications of Control Equipment

**Putting control equipment in service for which it was not designed frequently causes trouble. What these troubles are and how avoided**

By H. C. JENKS

*Control Engineer, Westinghouse Electric & Manufacturing Company*
*East Pittsburgh, Pa.*

MANUFACTURERS of electrical control apparatus are continually improving the standards of their products, and at the present time are producing equipment of very high quality. Occasionally, however, they receive complaints about the performance of the equipment in certain installations. These complaints are followed by investigations to determine whether the equipment is lacking from the design standpoint, or whether there is some other condition that makes the electrical equipment appear to disadvantage. Happily, the number of complaints from such sources is steadily decreasing. This is comforting, inasmuch as it points to increasing knowledge on the part of the men who have to select and apply control equipment, and of those who maintain it.

It will be interesting to recount some experiences in the misapplication of control equipment, and I will outline a few of the different points that have come up for study in connection with control applications. Examples of power or switching difficulties will not be included here, as these fields have problems peculiar to themselves.

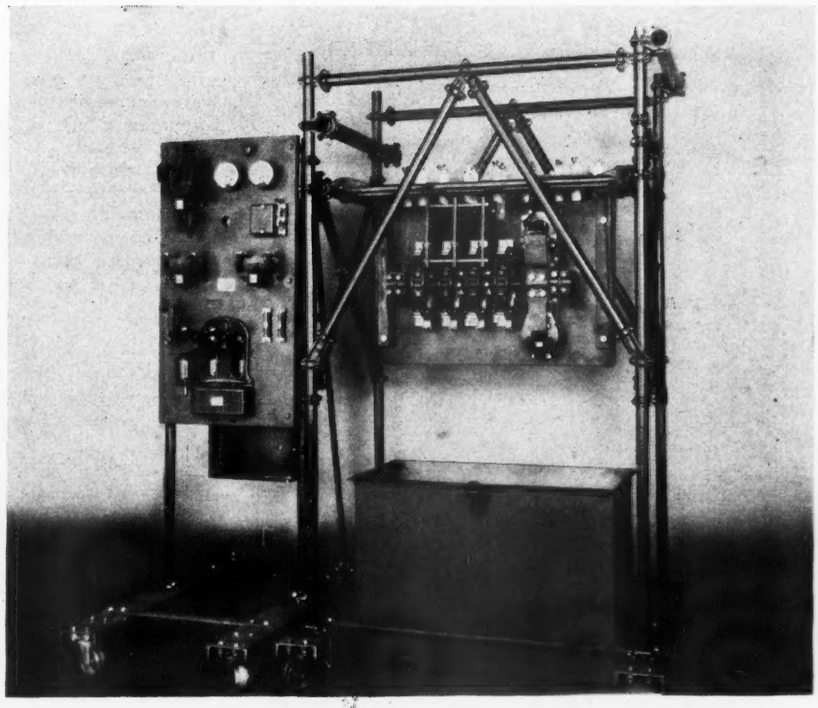
There have been some applications where the subsequent experience of the users has indicated that contactors rather than circuit breakers, or vice versa, should have been used. One of these cases was in the rubber industry. In this instance circuit breakers were used because of the voltage characteristics of the supply.

The mill was new, and there were the difficulties that normally arise

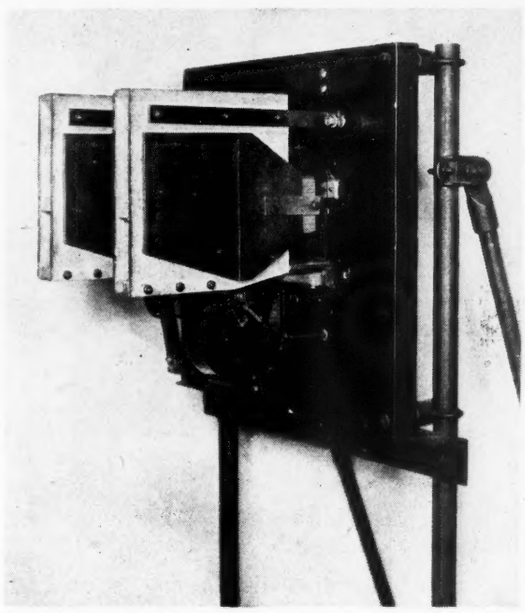
while breaking in new mechanical equipment. The laborers were inexperienced, although supervised by a few men who had been trained on similar installations. Inexperience probably caused more than the usual amount of sticking of rubber to the rolls, with resultant striking of the emergency stop-bars above the rolls.

Each stop required reversal of the mill and considerable inching, the breakers being required to rupture the inrush current of the motors at very low speeds, with full line voltage on the primaries. As a result of the large number of starts and stops during the first few months of operation, the breakers gave indications that they might not be satisfactory for this application. These indications took the form of extremely high maintenance on the main contacts and occasional evidences of distress from mechanical causes.

The manufacturer of the breakers, realizing that the mill was new and the workmen inexperienced, willingly gave advice and help, as well as some materials for slight modifications to the breakers. In time the breakers had to operate less frequently, and now the whole installation is functioning very well.



**When contactors can not be opened once a day to clean the contact surfaces, they should be immersed in oil. The contactor shown here with the oil tank lowered, has been designed for such applications.**



**For applications requiring frequent operation, air-break contactors should ordinarily be chosen. This contactor is designed for 2,200-volt service.**

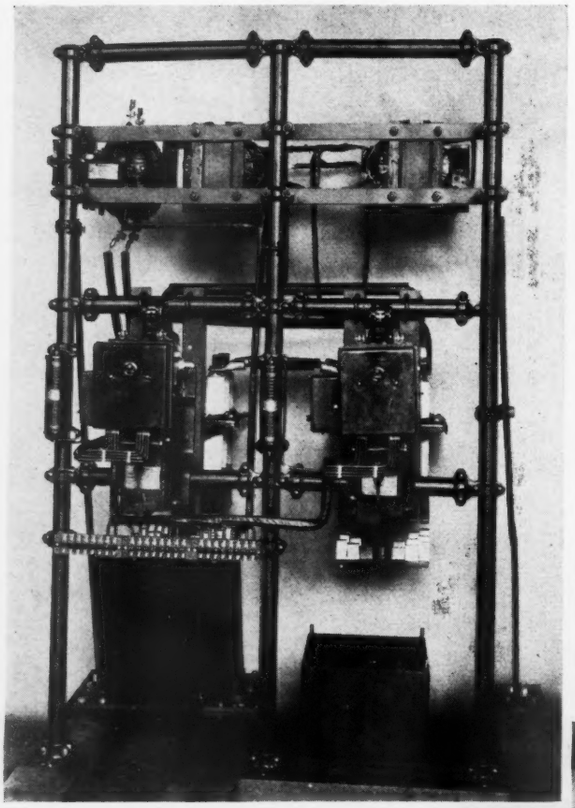
This experience indicates that first judgment, which might have condemned the apparatus and insisted that contactors, had they been available in the size and voltage required, be used to replace the breakers, may be reversed as operating conditions are modified.

Discussions regarding the application of high-voltage air-break contactors versus circuit breakers have also arisen. The conditions under which these equipments are to be installed or used must be given very careful consideration. There are locations, such as on traveling bridges or coal towers, in which oil circuit breakers would not be suitable for use. The slopping of oil due to vibration prohibits their application to such apparatus. The frequency of operation should also be considered when recommending this type of equipment. The fact that circuit breakers are designed for closing or rupturing a circuit at infrequent intervals must not be overlooked.

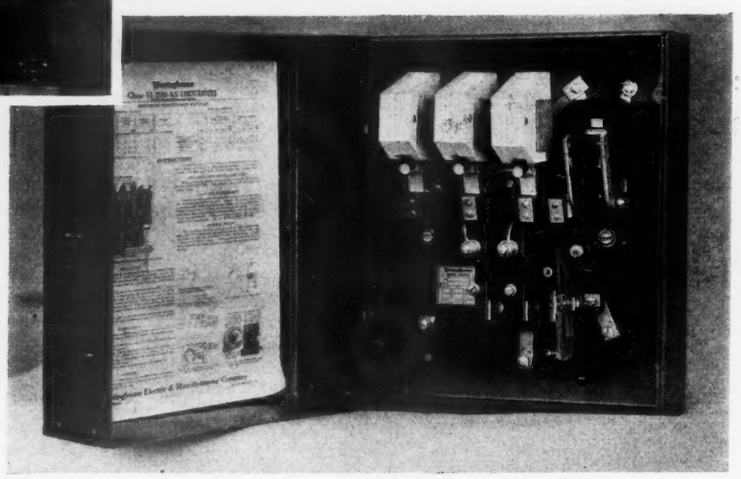
Air-break contactors were developed primarily for frequent performance, and should be applied whenever possible in preference to the oil breaker when the operations are in excess of ten to fifteen a day. Unfortunately, air-break contactors for high-current, high-voltage ratings have not been developed; so it occasionally becomes necessary to apply oil breakers even when it is known that, mechanically, the application is not the best for this equipment.

An example of the application of air-break contactors to extremely heavy service was found in the case of a mine hoist. This type of contactor was used because the very large number of operations a day made breakers out of the question. Operation was satisfactory for a considerable period. Subsequently, larger hoist equipment was installed. Unfortunately, the primary control could not be increased in size, as no larger apparatus utilizing air-break contactors was available. The frequency of operation precluded changing to circuit breakers. Therefore, the mining company has been satisfied to stand higher maintenance costs on this portion of the equipment than would be expected were it not so seriously overloaded.

In neither of the above examples was there real misapplication. They are cited merely to show that the first impression of the user may often



**Primary reversing equipment using oil circuit breakers. It is designed for applications where frequent starting, plugging, or reversing will not be necessary.**



**Across - the - line starter for normal-inertia loads. This starter may be augmented by a set of saturating current transformers, when heavy-inertia loads are encountered.**

lead to replacement of apparatus that later would have proved satisfactory after operating conditions had become normal. Also, they are an argument for a liberal viewpoint on the part of the user, as sometimes it is not possible to replace existing apparatus with designs that would be more economical in cost or maintenance.

### Drum Controllers Versus Magnetic Controllers

There are likewise limitations in the application of the drum-type, manually-operated controller and the magnetic-type controller. Manufacturers have provided drum controllers for various horsepower ratings, but the judgment of the salesmen and users must be relied upon to a considerable extent in using drum controllers in heavy-duty applications. Just because a drum device is listed at a certain horsepower rating does not necessarily mean that it will handle satisfactorily all applications using motors of the horsepower rating of the controller. The human element in the manipulation of the controller and the frequency of operation must both be considered.

One of the most frequently encountered applications where the tendency is to apply drums rather than magnetic controllers is on hoists for cranes or coal and ore bridges. In many instances the space factor strongly favors the drum-type controller and is given so much consideration that the operating standpoint is slighted. As a result, troubles have been experienced from the improper use of drum controllers where magnetic types should have been applied.

How can such troubles be cured? There are three methods, the first of which is not essentially a cure; the other two are alternatives.

The first method is to provide enough renewal parts to permit frequent changes of elements that wear or burn excessively. This expedient is usually nothing but a subterfuge that allows the controller to get by at considerable expense for renewal parts. Many firms will object seriously to this solution of the problem.

The first alternative is to replace with magnetic contactors those parts of the drum controllers subjected to the most serious burning. The contactors can be wired so that the drum controller, which originally handled the motor or resistor circuits, can be used to control the contactor coils. This arrangement takes the hardest service from the drum controller and puts it on the contact tips of the magnetic switches, which may be more able to stand the punishment.

The second alternative is to replace the drum controller with one of the magnetic type. The first cost of this change may seem difficult to bear, as it usually involves considerable labor and, in some instances, the construction of a balcony on the crane for the magnetic controller. However, the eventual substitution of a magnetic controller is almost certain to win hearty approval, as the upkeep costs will be so convincingly in favor of this type of apparatus.

### Manual-Type Speed Regulators

Complaints are often received by manufacturers of manual speed regulators for fan motors or other applications of this character. In the design of these regulators it is necessary to assume certain operating conditions for calculating resistor values and capacities. Should the actual load conditions not be the same as those for which the resistors were designed, the speeds obtained will not be of the order desired. The manufacturer is then unjustly criticised for supplying equipment that does not give the expected performance.

It is frequently expected that new resistors to meet the conditions will

be supplied without charge. Such expectations should not be entertained by the purchaser, inasmuch as the designer must work from conditions that have been assumed as average, or which were given to him when the equipment was ordered. Careful analyses of the operating requirements, prior to placing the order, are the only cure for such troubles.

A recent interesting experience involved the application of a timestarter to a motor driving a grinding wheel. The wheel was of large diameter, with high inertia. The timestarter had a horsepower rating equal to or greater than that of the driving motor. However, it was found that on starting extremely heavy current peaks were impressed on the motor and control, and eventually the starter failed.

A brief study showed that the trouble did not lie in the starter, but resulted because the time permitted for acceleration was not sufficiently great. The cure was then evident.

Now, when time acceleration is being so heavily stressed, considerable thought should be given to the application of this type of equipment to high-inertia loads. It is necessary for the purchaser to co-operate closely with the manufacturer, so that misapplications will not be made.

Another instance in which the time factor is vital, although in an entirely different manner, lies in the application of contactors for continuous rating. Contactors must be derated when applied to services in which they will be closed for long periods, without an opening action to clean the contact surfaces. Contactors have been known to destroy themselves when carrying currents that did not approach the normal rating. Operating conditions precluded opening the contactors for weeks at a time, thus preventing wiping away of oxides on the contact tips. The result was increasing contact resistance, and eventually destructive temperatures. The cure, in several such cases, has been to immerse the contactor in an oil bath.

Rheostats, drum controllers, and similar apparatus carrying heavy currents are perhaps even more subject to heating when in long-service duty, than are magnetic contactors. It is not so easy to immerse such devices in oil; hence, users should make sure that these devices are operated as frequently as conditions will permit, to clear away oxides on the contact surfaces.

Perhaps the most frequent source of complaint about the thermal overload relay has arisen from its application to motors driving heavy-inertia loads. To provide normal overload protection requires that the thermal overload relay be applied with trip values within possibly 20 per cent of the normal, full-load rating of the motor. The normal time constant of the relay being fixed, if the motor starting current does not decrease within a comparatively short time to less than the normal tripping value of the relay, the motor will be disconnected before it has had time to accelerate. A relay with higher tripping values will not solve the problem, as the motor will not be properly protected under all conditions.

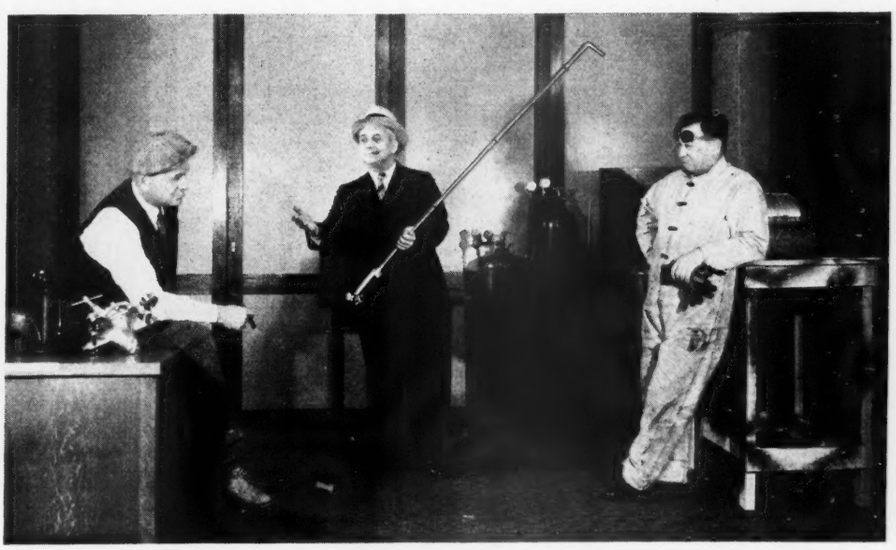
Applications involving heavy inertia should be given careful study before this type of relay is used. If the starting-current peak will last more than a few seconds, means must be provided for changing the proportionality of the currents flowing through the heaters, as currents above normal are drawn by the motor.

At loads of normal value or less the current through the heaters should be proportional to that drawn by the motor, whereas at loads above normal the relative proportion of current through the heaters should become less and less great as the load current increases. The usual procedure is to add to the control equipment a set of saturating current transformers, or their equivalent.

These are some of the items which, from the standpoint of misapplication, should be given more consideration. Others could be enumerated, but enough has been said to draw the attention of the user of such apparatus to the need for proper analysis of operating conditions before the equipment is ordered.

# A "Net Profits" Tableau

**Fundamentals of sound salesmanship were set forth in drama before the Gas Products Association convention, Sherman Hotel, Chicago, January 27th. Here's Mr. Hotdog, a salesman of the old back-slapping school, working on George Know, welding supervisor, and Bill Tight, purchasing agent. But Mr. Stayput, a scientific salesman with modern ideas, overcame the business depression objections and got the order by showing that purchase of the new and better equipment would really be a purchase of net profits. Ellsworth L. Mills, sales manager of the Bastian-Blessing Company and president of the Gas Products Association, wrote the skit.**



**All of Mr. Hotdog's eloquence couldn't clinch this sale. Mr. Stayput, costs, and "Net Profit" put it over.**

**A window stand is an inexpensive piece of equipment that helps to make the job of cleaning windows easier and safer.**

# CLEANEST WINDOWS: MOST DAYLIGHT

## Ways and means of cleaning

WHEN the village blacksmith of old set up his forge and anvil under the spreading chestnut tree he may have had some troubles, but washing windows was not one of them. Possibly that consideration influenced his choice of location, for washing windows is a job over which it is difficult to become enthusiastic, important though it is. Modern industry must, however, be housed in something more substantial than a few green leaves; it needs protection, and plenty of light. The era of windowless factories may be approaching, but for some time to come windows are likely to be dependent on to admit as much light as their size and condition of cleanliness make possible.

Outside the plant daylight costs nothing; to get it inside the plant costs money—for windows and the expense of keeping them clean. If for any reason sufficient daylight does not come into the plant, electrical energy must be consumed to make up the difference between the amount of light available and the amount required. Hence there are plenty of reasons, aside from the standpoint of appearance, for keeping factory windows clean. How this can be done in the most economical and efficient way is worthy of serious attention.

A considerable amount of equipment of various kinds for reducing the cost of window cleaning is available. For present purposes this equipment may be considered under two classifications: (1) Mechanical aids for enabling the workmen to reach windows that are difficult to get at. (2) Devices and materials with which the cleaning operation is performed.

There is considerable hazard involved in cleaning the outside of windows in multi-story buildings, and much ingenuity has been brought to bear on the problem of developing equipment that will make the work easier and safer. For example, one manufacturer of overhead materials-handling equipment has for some time been offering a window washing unit consisting essentially of a monorail track that runs around the outside of the building and supports a light trolley cage. The track is supported at the top of the building either from projecting eaves, or by special brackets. A type of carrier that is standard with this manufacturer is equipped with a twin-hook chain hoist and rides on the monorail track. The chain hoist, in turn, supports a detachable cage large enough to accommodate two men, with the buckets and equipment needed for the work.

The cage, which is inclosed to prevent the men from falling out, is fitted with casters so that it can easily be wheeled about inside the building, when not in use. A hand chain at each side of the carrier unit enables the men to raise or lower the cage as desired, and it can be propelled around the building by pulling, or pushing with the feet, against the building.

A similar, but smaller unit for inside service can also be had.

The same general type of equipment, differing somewhat in detail but designed to accomplish the same purposes, is available from another manufacturer. Another window washing unit will shortly be placed on the market by a third company.

Equipment of this character is in use by a considerable number of large industrial plants, railroads and other enterprises, but it would seem that the advantages which it offers should warrant even greater popularity. Swinging stages suspended by ropes and commonly used for cleaning, painting, and so on, have their place, but they also have serious disadvantages. At best their use involves a considerable injury hazard. Frequent inspection of ropes and other parts is necessary and no small skill and care in rigging are needed in order to prevent accidents. Furthermore, when they are used on routine jobs, such

as window cleaning, that must be done at fairly frequent intervals, the time required to collect, transport, and rig swinging stages or scaffolds inevitably increases considerably the cost of doing the work.

Aside from the safety features inherent in the window washing units described previously, the facility with which the work of cleaning windows, painting sash, making repairs, and so on can be done it is said to result in economies that offset the initial cost of the equipment.

If scaffolds or stages are to be employed it is poor economy to use anything but the best. Life and limb are too precious to be intrusted to the doubtful safety of worn or cheap rope and flimsy or inferior devices—particularly the home-made variety. Good, dependable equipment is available at prices that should offer little temptation to save pennies by taking long chances.

For cleaning windows on the inside as well as on the outside on the ground floor, ladders or portable scaffolds are commonly used. Of these a considerable variety can be had. Use is frequently made of the so-called step ladder, which has a shelf or rest on which a pail may be placed.

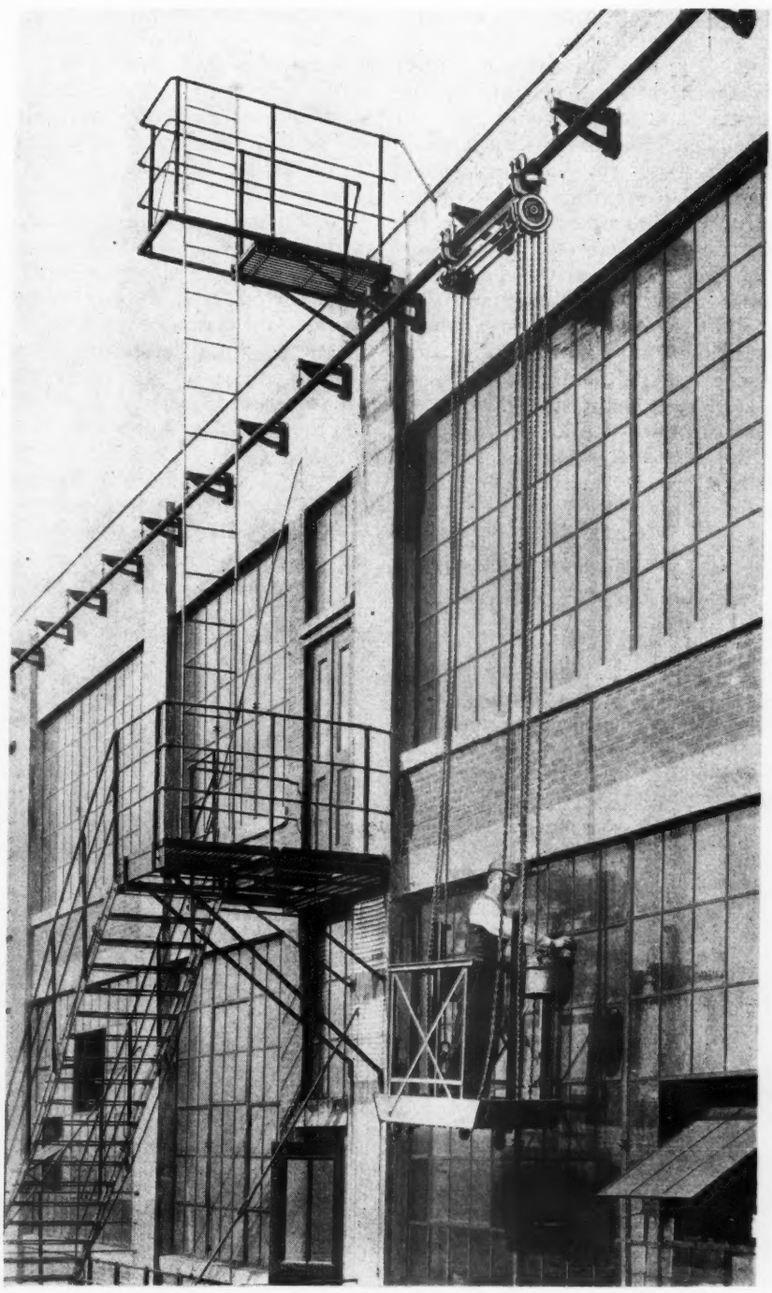
One of the disadvantages of step ladders is that they cannot be adjusted for height. Practically, this means that unless several ladders of different heights are available the window cleaner has to carry around one hat is long enough to reach the highst window on his rounds, even hough the other windows are much ower and could be reached by a horter and lighter ladder. For this eason some men prefer a light sectional ladder that has been developed particularly for use by the window cleaners.

Ladders of this type put out by one manufacturer can be had with the top section ranging in length from 6 ft. to 10 ft. The middle and bottom sections are both 6 ft. 3 in. long. The sides of the top section are brought nearly together at the upper end, which makes it possible to set the ladder up in places where the wall space available for supporting it is limited.

The bottom rungs of the top and middle sections are made smaller at the ends so that they may be slipped into slots cut into the upper ends of the sides of the other sections.

For cleaning windows that are too high to be reached by a ladder of the type described above, the conventional extension ladder may be employed. These are of several different styles, all of which are too well known to warrant description.

Another type of device that has been brought out to provide greater safety and ease when cleaning the outside of windows is known as a window stand or bracket. Although those of different makes vary in construction details the general principles employed are the same. Essentially, the device consists of a light but strong platform with suitable means for hooking it over the window sill on the inside, and a brace that bears against the building wall on the outside and helps to support the outer end of the platform. According to the design a guard rail may, or may not, be placed around the platform. In any case, these window stands fold



**Much of the labor and expense of cleaning windows frequently is due to the difficulty of reaching them. With devices of the type shown, size of window and height from the ground mean little to the cleaner. He can easily raise or lower himself by means of the chains at the sides, or travel around the building.**

up into a small compass and can be carried around easily.

Window cleaners' brushes, squeegees, and the like can be had from a number of manufacturers in a variety of sizes and shapes to meet almost any requirements. These items are too well known to merit more than passing mention; nevertheless, they are important enough to warrant sufficient care in selection to insure that a high-grade product, suited to the conditions, is obtained.

Another item of great importance is the cleaning compound used. The "soap-and-water" method which the housewife employs to clean windows is oftentimes not suitable for industrial use. One reason for this is the nature of the deposits that accumulate on the windows and skylights of plants. These deposits vary considerably in character, depending on the industry and local conditions. In many plants the deposits on window panes are light, appearing as a bluish or gray film that can be removed easily. On the other hand, the deposit may be of an oily or sooty nature that makes removal difficult. Fumes of various kinds may condense, or leave a deposit on windows. Again, there may be iron oxide dust present in the atmosphere, or rusting of steel sash may leave deposits of iron rust mixed with other substances on the glass. Removal of such deposits in an easy and efficient manner frequently presents a problem that is worthy of careful study.

To meet this situation many chemical and specialty companies have developed window cleaning compounds which are widely used. These materials are sold in the form of liquids, pastes, or powders, according to the composition of the cleaning agent and the conditions which it must satisfy. Saving in labor costs is one of the prime objectives sought in working out the formulas of these cleaning materials; hence they are all designed to perform their task with the minimum of rubbing. The chemical or detergent action of the cleaning compound is depended upon to remove the deposit. In most cases it is, therefore, necessary merely to apply the cleaning compound with a brush, rag, or mop, and flush it off, preferably with a stream of water from a hose. If it is not practicable or desirable to use a hose, rinsing with a brush or rag dipped in clean water will suffice.

How much does it, or should it, cost to clean the windows in an industrial plant? An interesting question, but one to which it is difficult to give a definite answer. The facilities for doing the work have an important bearing on the cost; the nature of the deposit, the frequency of cleaning, and the prevailing wage scale likewise enter in.

If the window cleaners must spend a good part of their time and energy in rigging swinging stages, or climbing up and down ladders and carrying them around, the cost per pane obviously will be higher than in a plant where more modern equipment is provided. If windows are allowed to go without cleaning for so long a time that heavy deposits are formed, the cost of removing them will, of course, be higher than when cleaning is done at more frequent intervals. Use of a poor cleaning agent will show up in higher costs, or less satisfactory results, or both.

As an example of how widely the cost of cleaning windows may vary, it is reported that the cost in one large plant is somewhat more than 3 cents per pane, for washing on the outside. In another plant in which modern window washing aids are employed, the average cost of cleaning is 75 cents per 100 sq.ft. of window area. This figure checks fairly closely with those obtaining in a large automobile plant.

A survey made some time ago disclosed that in this plant the cost of washing windows inside and outside was 51 cents per 100 sq.ft. The cleaners were paid 45 cents an hour. A proprietary cleaning compound was used, and the men worked on the platform of a scaffold built on a 1-ton truck. The scaffold carries a platform 10 ft. long, which can be raised 25 ft. above the ground. When the upper windows are all cleaned the platform is lowered so that the men can reach the second-story windows. Here the combination of windows that are not difficult to clean and means for getting at them without loss of time in rigging stages or other equipment makes possible a comparatively low cost per square foot of area cleaned.

A similar study in a hot-dip galvanized plant showed a cost of $1.60 per 100 sq.ft. of area for cleaning skylights. In this instance the smoke and fumes from the various processes leave on the surface of the glass a deposit which contains iron salts or oxides, and is very difficult to remove. The cleaners in this plant were paid $6 a day.

**An installation of modern window-cleaning equipment on the car repair shop of one of the big railroads.**

# PLANT ENGINEERS' FORUM

**Here is the eighteenth of a series of questions, each of which has at least two sides. A new question will be presented next month, and our readers' answers to previous questions also will be published. Write down your opinions and send them to the editor. Answers published will be paid for at an attractive rate.**

◆

## To Whom Should the Maintenance Department Report?

"Sorry I couldn't reach you last night, Frank," were George Shipman's opening words as he picked up Frank Fulleger at the latter's plant just after the whistle blew. "Had a nice little game on and wanted to give you a chance for revenge. Was the phone out of order?"

"Not that I know of, George. The wife and kids went to see Amos 'n' Andy and I went to the Maintenance Engineers' meeting."

"You mean that new organization of local maintenance and plant engineers? How was the meeting?"

"That's the organization, George, and the meeting was much better than I expected. I saw a lot of fellows that I hadn't had a chance to talk to for a long time. And I was surprised to find that I'm not the only one who has been going up in the world and who has been forced to use his 'bean' in his work."

"How do you mean?"

"Well, as you might have expected, the thing that interested those fellows most was how their departments and other departments of their plants ought to fit together."

"In other words," said Shipman, "organization."

"Yep—what kinds of work they are doing, what they ought to be doing, to whom they should report, and so on."

"Any fights?"

"Surprisingly few, George. Some of the men said that they have fights in their own plants, though, usually with the production departments, and almost always because the production people want to look upon them as a 'repair gang.'"

"Well, they do the repair work, don't they?"

"Yes, but most of them do a lot more. They prevent the necessity for repair. Except for the production machines they get in the kind of equipment that gives the largest trouble-free life. They—"

"Hey, no lecture, Frank. I know your story. Didn't I help you work out the details of your own job?"

"Excuse me, George. Of course I have no business giving you a sermon. The thing kinda got under my collar, I guess."

"You know, Frank, maybe they didn't discuss the right question—or at any rate put it in the right form. After all, aren't they concerned with how they report in the plant? I mean, should they report direct to management or to the production department?"

"Say, I believe you've hit the nail on the head. I think I see possibilities in the question put that way. I'm going to suggest that for the topic for the next meeting. I'll phone Jackson tonight—he was elected chairman, you know."

* * *

*And what help can you readers of* INDUSTRIAL ENGINEERING *give before the next meeting of Frank's association is held?*

**Should the maintenance department report to the production department? Why or why not? Or should it report directly to the management? Give reasons.**

*(Answers to previous questions start on the following page)*

# READERS' ANSWERS

## *to previous questions*

### How Valuable Are Plant Visits?

*(Question presented in the February issue)*

I THINK that plant visits are a good thing. I had a chance to get away for two days last week and I found out more and saw more than I ever expected. In talking with the electrician in those plants I helped to settle some of his problems and also some of mine. I mentioned to the superintendent that the time I was away was worth double time to me and to the firm; he was glad to hear such a report. It's foolish for a man to think he knows everything.

We have three plants with nearly 1,000 hp. in electrical equipment—90 motors ranging from ¼ hp. to 76 hp. Last year I kept check on equipment myself and there wasn't five hours lost time during the year. There has been only one accident in 26 years in the electrical department. Every month the motor bearings are emptied, washed out, and fresh oil is put in. Oil for starters is strained and put back in. Electric contacts are inspected, and control panels for 550 and 440 volts are checked for grounds twice a week.

J. B. BAILEY, *Electrician*
*Ruddy Manufacturing Company*
*Brantford, Ontario, Canada*

I BELIEVE that the value of plant visits usually is overestimated. If a specific machine or method is to be investigated, the visit is likely to be worth while, but where the visit is of a general nature the benefits derived are meager as a rule. An occasional call on neighboring plants usually is worth the time and trouble, but a trip involving several days and traveling expenses is another matter.

If we are to consider a regular program of visits to other plants, we also must stand ready to entertain their representatives. It will readily be seen that such a program might become quite cumbersome and leave little time for the plant engineer to fulfill his regular duties.

We all agree, of course, that it is necessary for the plant engineer to keep posted on the latest developments in equipment and methods, but such information usually can be obtained more readily and more authentically from sources other than plant visits. Our daily contacts with sales engineers and our attendance at the meetings of the various engineering societies, together with reading the works of leading authorities and the perusal of such magazines as *Industrial Engineering*, are the ideal methods to follow. Recently we were interested in the purchase of a certain type of automatic machine and found that it was not necessary to visit other plants to see this machine performing under varying conditions. The salesman carried with him a small moving picture projector, and we were able to sit in our own office and see what was being done.

On several occasions I have visited other plants and caught some other engineer's enthusiasm about a method or process, but usually found on returning home and giving the matter further consideration, that the idea was not adaptable to our plant.

We all have our favorite methods, but they may be far from ideal and the imparting of these methods to others sometimes is of doubtful value. In the last analysis it will be found that there is no substitute for intensive study and hard work and that most of our problems will have to be solved in this manner in our own plant rather than relying upon the knowledge of our neighbors.

C. W. SCHWABE
*Superintendent Mechanical Department*
*Mallinckrodt Chemical Works*
*St. Louis, Mo.*

MAINTENANCE engineers should make a practice of visiting other plants. Maintenance engineering as a whole has advanced in direct proportion to the extent of the interchange of ideas and information concerning plant practices.

In view of the benefit received the company should pay the traveling expense; after all, that is not such a terribly expensive way of buying ideas.

A plant helps itself by helping its competitor in an interchange of information. Most frequently the very act of giving information reacts to the benefit of the disseminator.

The best way for any concern to make sure that it is using up-to-date methods and equipment is to distrust its present methods and equipment. Plant visits will point the way toward new methods and new machines. Such visits will pay the concern many times over the cost of financing the trips.

HARRY KAUFMAN, *Engineering Dept.*
*Naval Aircraft Factory*
*Philadelphia, Pa.*

I AM of the opinion that the regular visiting of plants by maintenance engineers is not necessary. A casual visit is not of much practical benefit. I do not condemn a special visit to a plant engaged in kindred work where the visitor is in position to exchange valuable information.

I had experience in a specific case where all concerned benefitted. I had some rather peculiar problems in crystallizing and drying a magnesium salt. My firm arranged a visit to a firm using a similar process in connection with another chemical. The plant engineer was most obliging in every respect and gave me many useful hints that I was able to use to good advantage. I was there strictly on business and no time was lost in social amenities.

On the other hand, an assistant of mine made a habit of visiting every plant that he could get into. He would drive several hundred miles to "look over the plant."

He admits that in these visits he had no time to learn anything of real value, because he was not informed ahead of time as to what were the problems of the plant, and that the visits were merely social get-togethers.

M. C. COCKSHOTT, *Mechanical Engineer*
*J. B. Gill Corporation*
*Long Beach, Calif.*

IT was a trip into a lumber camp years ago by an executive of one of the great electrical industries of today that resulted in applying the principle of differences in expansion and contraction of dissimilar metals to a thermocouple control for regulating temperatures. The idea was gotten from a crude but practical arrangement by a tender of fires who liked to nap between periods of firing up. When the fires died down to a predetermined point a plate of different metal on the fire box door contracted, releasing a log which had been set against it. The noise of the falling log awakened the man. It is said that that trip made millions.

A couple of years ago, within a plant of my acqaintance, extensive changes in transmission lineup were deemed necessary. The new scheme called for a number of expensive units. A visit by the plant engineer to a neighboring industry resulted in using, instead, the multiple-V belt, at that time just making its appearance

A plant engineer passing through a factory noticed two laborers removing some old concrete foundations with a concrete breaker. Only two men were doing the job that within his own plant would require three or four. He bought one.

Regular, scheduled plant visits by plant and maintenance engineers are looked upon as intangible and often doubtful value by many executives and, in my opinion rightly so. They are quite likely to develop into a habit. Far greater benefit can be derived when such visits are made with a definite objective if only to check up on certain installations or methods.

H. L. SCHULTZ
*Assistant Superintendent, Maintenance Department*
*The Carborundum Company*
*Niagara Falls, N. Y.*

## Bonus for Maintenance?

*(Question presented in the January Issue)*

IS it feasible to pay a bonus for maintenance? Emphatically, yes. In plants where I have been employed I have encountered three plans, all of them good for management and worker. These plans were used in all cases, including individual repair and emergency work.

The time and expense incurred in gaining the data necessary to put into practice such a system is fairly large, but if there be an amount of this work, enough to make such a plan considered, then it will pay for itself much more quickly than will a plan for any other type of work.

What plan to use depends a whole lot on the type of maintenance. I would not attempt to put on paper any of the three I know, because they would not fit all cases. The engineer should study what has been printed concerning the subject. Once the underlying principles are known the rest will be decided on the knowledge of the individual needs. It is surprising to meet so many engineers who believe that maintenance bonus is an experiment. It is not; I can name more than ten shops here in this district which are having a large measure of success with it.

CHARLES R. WHITEHOUSE, *Standards Engineer*
*The Holtzer-Cabot Electric Company*
*Boston, Mass.*

A MAINTENANCE bonus or premium plan which attempts to speed up repair work fails because of the difficulties involved in attempting to establish standard time factors.

Maintenance men for the most part are little concerned with the causes of repairs. Even the most conscientious worker considers his job well done when satisfactory cost reductions have been effected through reductions in repair time.

A maintenance bonus which is calculated from a basis of percentage of machine lost time to total time is an incentive to the maintenance men to seek and eliminate the causes of the repairs, the cost of which, after all, is the major item with which the management should be seriously concerned.

H. S. DEELEY, *Planning Engineer*
*Canadian Johns-Manville Company*
*Asbestos, Quebec, Canada*

**CHAS. E. KIRKBRIDE, Jr.**

**Project Engineer, Naval Aircraft Factory, United States Navy Yard, Philadelphia, Pa., and Forum contributor, believes that the formation of a national association . . . should be supported as a means of exchanging ideas . . . and forwarding the individual and collective skill and information of maintenance engineers.**

## Shall There Be a National Association of Maintenance Engineers?

*(Question presented in the November Issue)*

THE organization of a national association of maintenance engineers should prove helpful to anyone engaged in this kind of work.

I know of none of the engineering organizations in existence that cover this particular field or give maintenance work much recognition.

I should rather see the association start from "scratch" than to be a reorganization of associations already formed for other purposes. My observation has been that the local engineering clubs are made up

largely of salesmen, college professors, and contractors whose interests are not the same as those of the man engaged in industrial work.

Most concerns look upon associations of this sort with favor and are glad to permit their employees to take part in their activities. In many cases they are willing to pay the dues and other incidental expenses.

C. W. SCHWABE
*Superintendent, Mechanical Department*
*Mallinckrodt Chemical Works*
*St. Louis, Mo.*

## Who Shall Specify Equipment?

*(Question presented in the October Issue)*

EVERY plant engineer should specify what he wants, but such specifications should not be considered final and absolute. It may be that the purchasing agent knows something about engineering, although it is his job to know all about sources and purchase of material.

Assuming that the plant engineer knows something about prices and buying, it is his job primarily to know the kinds of tools, machinery, and other equipment that will best serve the purpose.

For cases of this type, but where the functions of each do not overlap, the plant engineer should not be handicapped.

The elimination of many undesirable features can be obtained by comparing views. Sometimes the most expensive equipment is the cheapest in the end because of low maintenance and replacement costs. Oftentimes a cheaper article will serve the purpose of the more expensive article. Nevertheless, it is the natural tendency of the plant engineer to obtain the best and that of the purchasing agent to expend the least amount of money.

Any suggestions coming from him that tend to save money without sacrificing quality should be considered. Not to consider them indicates a lack of co-operation which is necessary for the efficient operation of the plant.

A. W. DURR
*Development Engineer, Akron Plant*
*American Hard Rubber Company*
*Akron, Ohio*

IT is my opinion that when purchasing agents do not purchase the equipment specified by the plant engineers they are laboring under a wrong opinion with regard to their correct service to the industry. My own experiences for several years have been sufficiently satisfactory in every detail in my contact with P.A.'s that I can scarcely believe that any P.A. of today could have a wrong viewpoint.

There are many items of supplies the buying of which should be left entirely to the P.A. and there are some supplies that the P.E. should specify definitely. Structural steel shapes, for example. The P.E. should specify size, shape, and weight in pounds per foot. These the P.A. should be left to purchase wheresoever he sees fit. The same is true of window glass, flooring, cement, sand, boiler tubes, firebrick, cold rolled steel.

Other supplies such as belting, oils, valves and fittings, and packings should be purchased exactly as specified by the P.E.

Both men are employed to serve their plants; they must co-ordinate their efforts; each must recognize the particular place in which the other fits. The P.E. must leave open every opportunity for the P.A. to purchase the materials at the lowest possible price. When the P.E. specifies some particular brand of material or some particular type of equipment, it is the duty of the P.A. to purchase that material or equipment exactly as specified.

HARRY W. BENTON, *Plant Engineer*
*Pratt and Whitney Company*
*Hartford, Conn.*

## What Maintenance Policy During Depression?

*(Question presented in the September Issue)*

DURING any depression, if the maintenance engineer has a free hand, there is so much to do in preparing for the busy period. Often, however, in small organizations the management appears to be rather nervous of what they consider unwise and unproductive expenditure, and, as usual, start cutting the payroll.

Providing this objection is overcome, much can be done by renovating one section of the plant at a time.

In the mechanical end machines should be completely overhauled, cleaned, all wearing parts checked, bearings taken up, etc.; painting or repainting and washing where needed.

Electric fixtures tested and overhauled. New lights provided. Shades washed and cleaned.

Concrete floor scraped and all pitted and worn places repaired.

Railroad tracks checked and lined up anew, replacing worn rails, broken ties and so on.

At this time boiler inspections should take place, having first arranged for the insurance inspectors. Replace all worn tubes; adjust mechanical stokers; calibrate recording gages and instruments; rebuild walls where required.

In doing this work a special work order is often made out, so that the costs can be segregated and charged off against the various departments during the ensuing year.

Any extensive changes and alterations in production methods involving mechanical alterations should have been planned, all equipment ordered and care taken to see that it is on the ground in time to be installed. It must be understood that this is only a general scheme as no two plants proceed alike on work of this character.

In the stores department this is time for inventory, and replenishing material needed for the ensuing year. In drawing up the "Depression-Period" program I think the following procedure should be carried out.

Interview department heads and get their views on what is needed, then have the maintenance engineer make a thorough inspection. With this information on hand a program of work for each department can

**CARL A. WAGNER**

**Who, as Chief of Electrical Service and Sales for the General Machinery and Supply Company, Denver, Colo., was a frequent contributor to Forum discussions.**

be prepared. Estimate the cost of the work to be done, and if necessary, submit it to the management for approval.

With the tentative program made for each department align the maintenance department to suit, cutting to a minimum in certain branches, increasing temporarily in others.

This period really is the busy time for the maintenance engineer and his department, and in our case vacations must be put off until there is slack time, if there is such a time for the maintenance department.

M. C. COCKSHOTT
*J. B. Gill Corporation*
*Long Beach, Calif.*

## How Big Is Maintenance?

*(Question presented in the May Issue)*

HOW widely understood is the maintenance job as outlined in the Forum? Not very well, I fear, especially in the smaller shops. In the different lines of mechanical endeavor that I have been connected with in the past there is one small manufacturer whose methods could be copied by all with, I believe, great benefit.

The maintenance engineer is connected with almost every department, including the purchasing. No new machinery authorizations can be put through without his consent, as he knows just what the various types are going to run into for repairs. He must personally sign all purchase orders for repair parts, materials, oils, etc., so as to eliminate the possibility of misunderstood orders or the purchasing of something just as good.

When the sales department is figuring on a rush order, or an order that will call for the overtime operation of some of the machinery, he is consulted as to the chances for overloading before the promise is made. He also maintains a periodic check-up of the machinery to keep it in order, and does not wait for a breakdown. He holds the man at the machine directly responsible for keeping an eye on the condition of the shafting over his machine, or the motor attached to it, regardless of the fact that he has an oiler to do this work. This may sound like a lot of work, and it is, but it is the type of work that saved the company thousands of dollars the first year.

There is absolutely no friction, due to his being "in on" the work of the other departments, as he handles this diplomatically. Some say that such a man as the one described is hard to find. That may be so, but the time for putting a man in this type of position merely because he is a good mechanic is past. It is a big job and commands a big man to fill it.

CHARLES R. WHITEHOUSE, *Standards Department*
*The Holtzer-Cabot Electric Company*
*Boston, Mass.*

## Should Maintenance or Production Department Control Cranes, Elevators, and Trucks?

*(Question presented in the April Issue)*

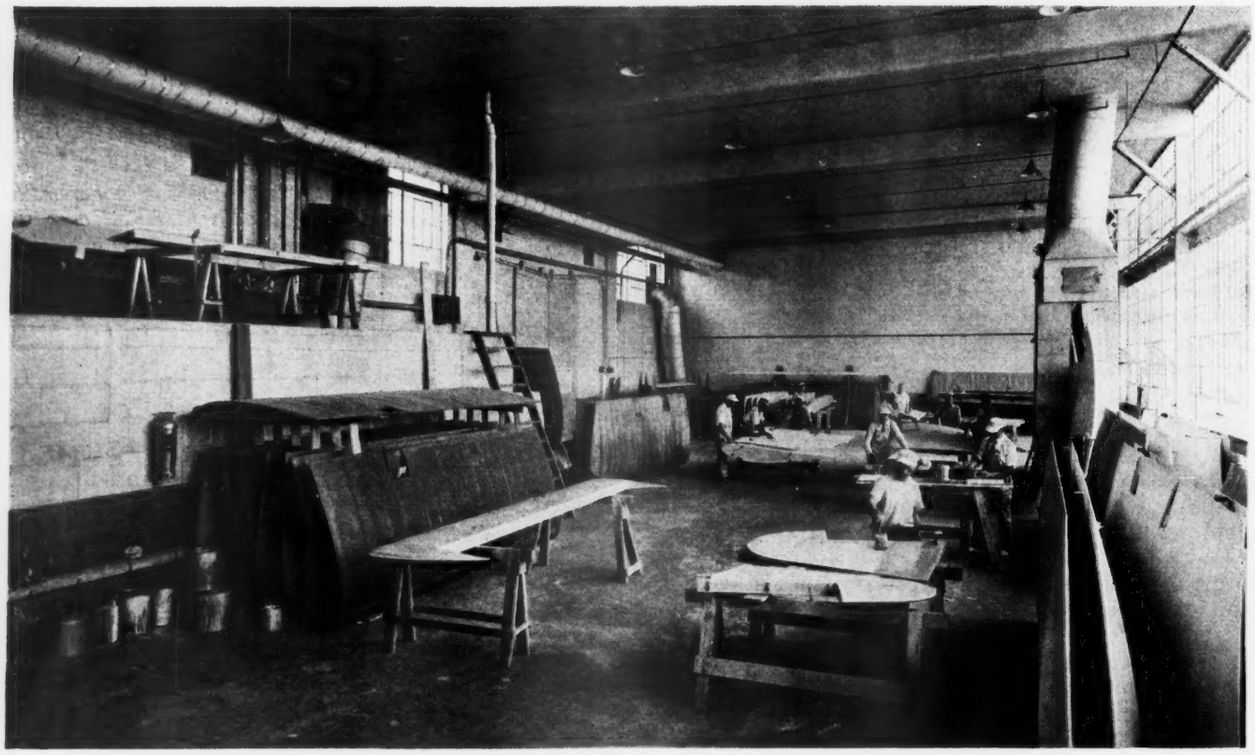
THE regulations which govern the operation of cranes and elevators will depend entirely on the nature of the product, type of plant, and the size of the equipment involved. The first rule which should be thoroughly understood by all is that the maintenance department shall have absolute authority as to the repairs, oiling, and upkeep of the equipment and under no circumstances shall other departments be allowed to tamper or make adjustments. All men who are responsible for the operation of the equipment, whether they are under the control of the production or the maintenance department, must be trained by the maintenance department in the operation of the apparatus. The operating men, however, although thoroughly trained in the performance of the machine, should not have the responsibility for repairing and lubricating.

There are two classifications for consideration, the first of which is a factory in one building. I recommend that the man operating such equipment be a part of the maintenance department, but that he take his orders for the handling of materials from, and work in cooperation with, the production department. Under these circumstances he can be under the eye of the maintenance department head who also has his work in that particular building.

In the second classification is the group of buildings where the operating men are more or less on their own responsibility because the central maintenance department is located in a structure of its own. Under these circumstances the superintendent of the building should have jurisdiction as to the operation of the equipment in handling and routing materials. His authority might even go so far as to cover the employment regulations of this particular operator, but even under these circumstances the man should be trained by the maintenance department.

I recommend that, regardless of the type of plant, when the equipment involved is of a complicated nature, the entire responsibility be up to the maintenance department as to its operation. Under all circumstances, however, co-operation between the production and maintenance departments should be most cordial, because frequently the operator must move material in conjunction with production policies.

K. D. HAMILTON, *Mechanical Department*
*Geo. E. Keith Company*
*Campello, Brockton, Mass.*



**Section set aside for applying dope to wings. The wing spray-booth equipment is shown at the right. Fumes from the dope applied by hand (first two coats) are exhausted through wall ducts.**

# Changing Air Every 2½ Minutes

## *A dope-room problem*

By W. A. COULTER

*Sikorsky Aviation Corporation*
*Bridgeport, Conn.*

AN interesting problem in ventilation has been worked out for the dope room at the plant of the Sikorsky Aviation Corporation, Bridgeport, Conn. Dope is made on a base of cellulose nitrate and its function is to tauten the fabric of the wings, fill and seal the pores, leaving a smooth surface for the finishing coats of lacquer, enamel, or pigmented dope. It is highly inflammable and the fumes are explosive when mixed with air so that proper ventilation is absolutely necesary not only for safety's sake, but also on account of the fact that the fumes are poisonous and seriously affect the lungs of the workmen. A concentration of about one-tenth of one percent is considered safe from the explosion point of view, and practically harmless to the operators. Good ventilation is also essential to producing a good finishing job on the wings, and will eliminate to a great extent the use of expensive thinners and anti-blush compounds.

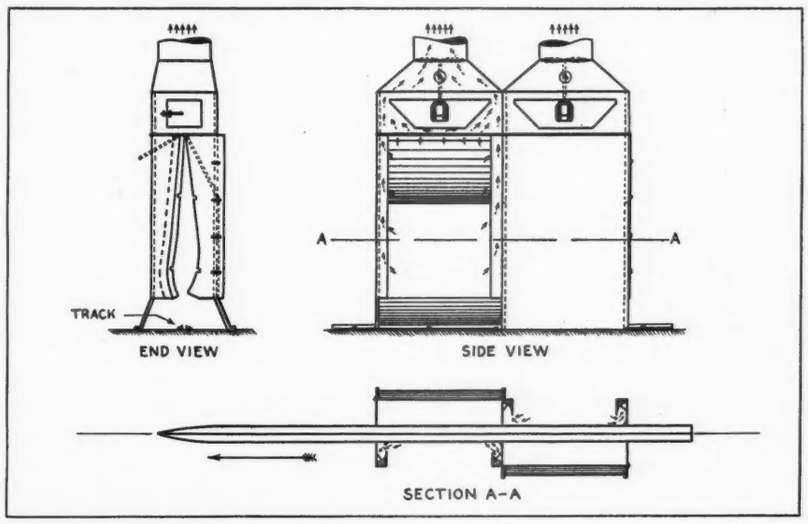
With regard to fume removal, there are two conditions that have to be taken care of. In order to be sure that the dope gets into the fabric properly the first two coats are applied by brushing. The fumes resulting from these operations, being heavier than air, tend to sink to the floor. The third and fourth coats, which consist of dope pigmented with aluminum powder, are sprayed on. Starting from a higher level, the fumes from these spraying operations, which contain solid matter, also tend to fall to the floor.

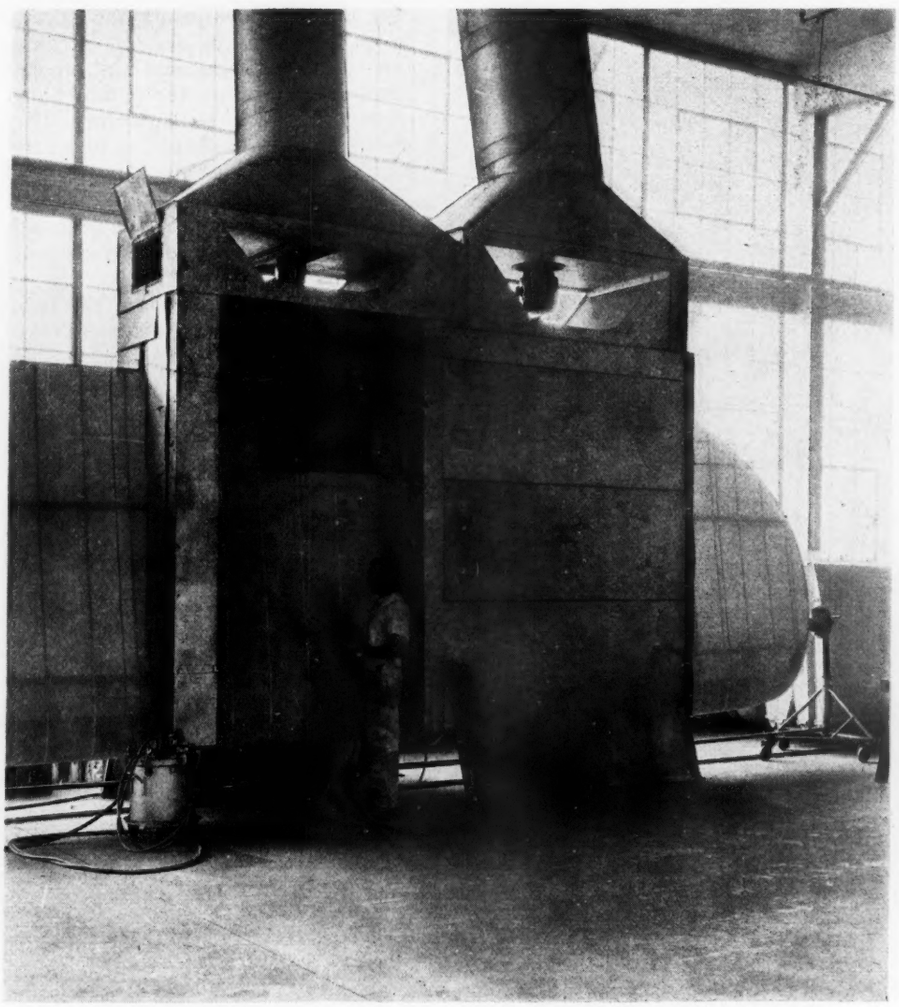
This dope room, which is 120 ft. long, 50 ft. wide, and 22 ft. high (contents 132,000 cu.ft.), is separated from the factory on three sides by fire walls; the fourth side (120 ft. long) is the south wall of the factory, and it consists mainly of glass. In planning the ventilation the problem was whether to consider the whole

room or a portion of it as the spray booth. To treat the whole room as a spray booth would mean the frequent exhausting of an enormous amount of air with consequent loss of considerable heat. It was decided to confine the brushing work to the east end of the room and locate ventilators in this area with the outlets near the floor so that the fumes from the work would be constantly withdrawn and at the same time general ventilation for the entire room would be supplied. The spraying was to be done in booths or near exhausters so that none of the fumes could spread around the room.

The exhausters used for general ventilation are of the blower type and consist of two 30-in. fans having a total capacity of about 10,000 c.f.m. They are placed on the roof of the low bay which runs into the wall of the dope room at a height of 12 ft. The exhaust pipes run up to the blowers at two corners of the room, and two ducts from each, with openings about 4 in. from the floor, run along the wall for about 15 feet.

Air is supplied to the room through four unit heaters, each with fan capacity of approximately 5,000 c.f.m. These fans are mounted as near the ceiling as practicable, outside of the fire wall and on the same side of the room as the exhaust ventilators. The air supply is taken from the main factory, is heated, and is blown into the dope room at a height of about 18 ft. The blast is directed downward at a slight angle and the cooling effect as it strikes the windows on the opposite side of the room causes it to drop naturally to the floor. Since the exhaust fans are pulling air out along



**Spray-booth arrangements for doping wings. End view at left shows the track for the portable stand carrying the wing past the sprayers' stations. Direction of air circulation is upward as indicated by the arrows in the side view at right, and toward ducts at the sides as shown in the section *AA* with the wing in position.**

**Close-up of spray booths showing how the exhauster motors are located outside of the fume areas. Ducts in the corners of the booths feed into the main duct overhead, which discharges to the atmosphere through the roof.**

the floor of the supply side of the room, a regular and definite circulation is established. To maintain this circulation doors and windows must be kept closed.

Openings were cut in the fire wall to take the air supply from the unit heaters, but these vents can be automatically closed in case of fire, through the melting of a fuseable link, and thus prevent any connection with the main factory.

To facilitate the spraying of the wings special equipment was designed. It differs from the ordinary spray-booth design and is unique in that both sides of the wings can be sprayed simultaneously, thereby effecting a considerable saving in space requirements and time devoted to the spraying operations.

The wings are carried in a vertical position sidewise on a portable stand which is driven by an air motor by means of a cable. Movement of the stand through the booth is entirely automatic.

With this layout the operators can then concentrate on covering the surface necessary as the wing passes each station. The arrangement consists of two adjoining spraying stations or booths facing in opposing directions and constructed so that a wing can pass through one booth and then the other.

The spray inclosure for each operator (one for each side of the wing) is formed by two ducts 5 ft. apart and shaped approximately to the camber of the wing with the openings about three inches from the surface of the fabric. These two ducts at the side are coupled to a duct which joins them at the top, the opening of which is directly over the trailing edge of the wing.

This special arrangement makes a continuous opening for the exhaust close to the wing surface so that excess spray is immediately exhausted either to the left or right of, or from above, the operator.

To prevent air leaking through the spaces between the ducts and the wing, leather baffles with wide, flexible edges have been provided, the leather bearing against the surface of the wing as it moves along. At the side where the wing emerges from the booth the leather baffles cannot be used because they would mark the newly sprayed surface; however, they are set-up to the wing surface as close as possible. These baffles are adjustable so that they can be moved in or out to suit the thickness of the wing that is being sprayed; also the size of the openings in the ducts can be varied by means of dampers. For instance, it might be desirable to shut off the suction in the lower end of the duct if a wing of smaller cord or width is to be sprayed.

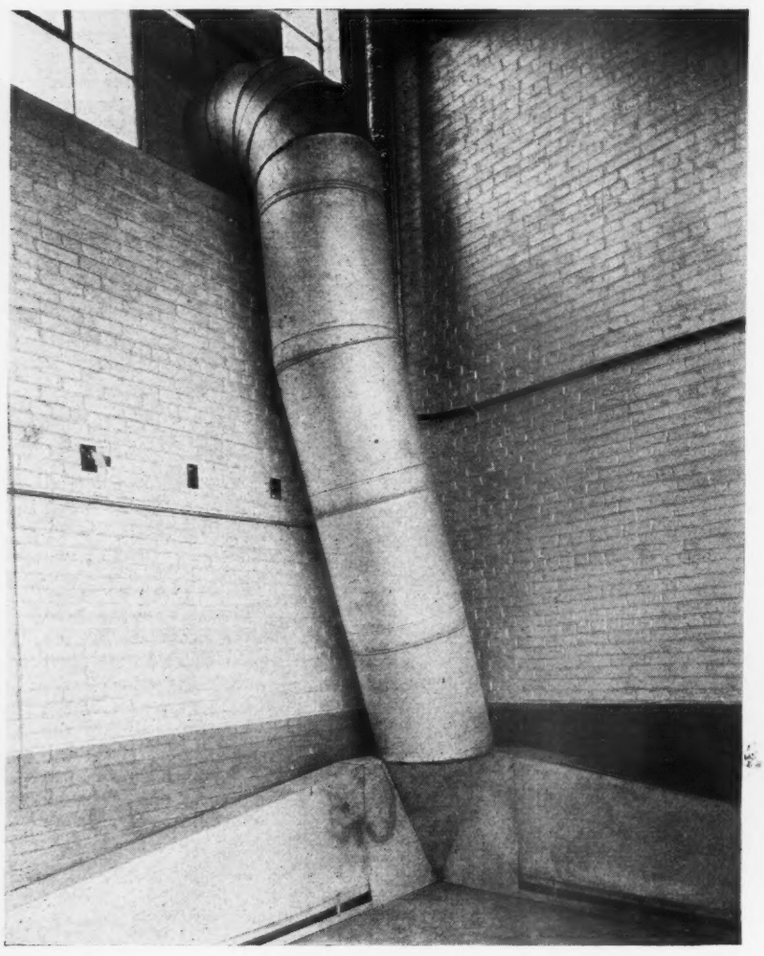
Each unit of this spraying arrangement has its own exhaust fan of the two-bladed propeller type, 36 in. in diameter, with capacity of about 16,000 c.f.m. The fans are driven by 2-hp. motors on extended shafts, and mounted so that the motors are outside of the fume area. The exhaust stacks lead directly to the outside through the roof.

The total capacity of all fans and blowers approximates 50,000 c.f.m.; hence a theoretical air change in 2½ min. is possible.

However, no appreciable advantage is gained by operating the general exhaust fans while the spray-booth fans are in service, because the latter works against the others, tending to interrupt the natural flow of vapors toward the ventilators. The air supply is not sufficient to take care of the total exhaust capacity.

With the thought of fire prevention always in mind all equipment and installations are of the commonly approved types.

Strict regulations govern the conduct of operations in this room. All fan motors are of the totally inclosed induction type, and are controlled by magnetic switches located outside of the dope room; however, vapor-proof, push-button stations are located conveniently close to the operators. Safety in artificial lighting is provided by means of vapor-proof fixtures.



**Type of exhaust ducts used for general ventilation. The intake is almost at floor level in the vicinity of the doping operations.**

# AROUND the WORKS

**A section devoted to short articles describing practical methods devised to meet specific operating conditions. The items may refer to details of installation, inspection and testing for maintenance, wiring, repair, and replacement.**

## Asphalt Mix First-Aid for Concrete Floors

HOW many times have you had the experience of trying to patch a hole in a concrete floor, or of having a poorly constructed job go to pieces? Oftentimes I have found it necessary to dig out an old floor and re-lay with new concrete because it was found impracticable to patch shallow holes. The concrete would come out as soon as it had set. Considerable trouble with a large concrete floor was eliminated by using a mixture which satisfied all conditions of application and operation.

This floor, as shown in the illustration, had been patched. The darker section to the left is the old floor; the lighter sections are patches. The material used was an asphalt compound mixed with sand and Portland cement, which looks very much like a granolithic finish. It can be laid cold and placed directly on top of the old concrete floor.

An asphalt primer is first used to insure a good bond, after which the material can be easily spread. Also it can be tapered to a feather edge at the joints so as to leave a smooth surface for trucking.

One patch can be bonded to another at any interval and insure a smooth job. It will set in from 24 to 36 hr., so that the job can be done over a week-end without any difficulty. When used for patching walls or floors it can be painted after first covering with a heavy coat of shellac.

Equally good results are obtained when laid on concrete or wood, and it is not only dust proof, but waterproof. Most operators after working on the hard concrete floor notice a difference with this new material, as there is a certain resiliency which is not present with concrete.

Plant engineers who are bothered with resurfacing trucking aisles, patching sections of flooring from which machines have been moved, will find this mixture very satisfactory.

K. D. HAMILTON.
Mechanical Department
Geo. E. Keith Company
Campello, Brockton, Mass.

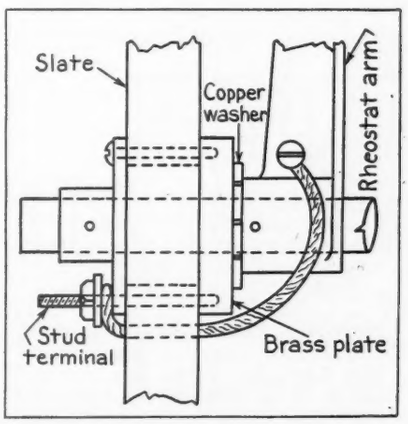
**Light spots in the dark section are patches of an asphalt mix prepared on the job and applied cold on the old concrete floor.**

## Flexible Lead Overcomes Dangerous Speeding

HAD the arm of the vernier rheostat in the shunt-field circuit of a large mill motor been equipped with a flexible lead to insure contact between it and the contact plate, regardless of wear, we would have been spared considerable trouble from dangerous overspeeding.

This 850-hp., 250-volt d.c. motor drives an intermediate set of rolls in the rod mill in conjunction with two 300-hp. motors of the same type which drive two sets of four-high roll stands. These three motors receive their current from a 1,000-kw. m.g. set located in the same room. The operation of the motors is controlled by one man in a pulpit, where he observes the various passes. Motors have both main and vernier rheostats in the shunt-field circuits to secure very close speed regulation.

One day, after more than a year's operation, the operator complained that the three motors would not respond to speed regulation, and were varying from 30 to 40 r.p.m. Getting at the seat of trouble was tried by the process of elimination. The electrician ran a separate test on each of the 300-hp. motors, covering the entire speed range. Both were found to be satisfactory.




**The simple expedient of attaching a flexible lead between wearing contact points insures good electrical contact, regardless of wear.**

When the 850-hp. motor was started with no load, it would speed up, tripping the over-speed device, and would draw 4,000 amp., thus reducing the voltage of the m.g. set 25 volts. This drop was the cause of the two 300-hp. motors not holding their speed when all three motors were running. As a result the electrician investigated the shunt-field circuit of the 850-hp. motor, locating the trouble in the vernier rheostat.

On this rheostat there is a round brass contact plate about three inches in diameter on the front of slate. Into it is screwed a stud used as a terminal for the lead wire from the rheostat external connections. On this brass contact rides a round copper washer about one and one-half inches in diameter, which acts as a brush to carry the current from the brass contact to the rheostat arm. From the accompanying diagram one can readily see that there is no spring or adjustment to maintain a good contact between these two current carriers, and which was the cause of the trouble.

From continuous operation the copper

washer had worn, failing to make good contact, and causing an open circuit in the shunt-field circuit.

To prevent its reoccurrence a flexible lead was attached between the brass contact plate and the rheostat arm thereby insuring a good electrical connection between the two. Similar leads were then supplied on all six rheostats.

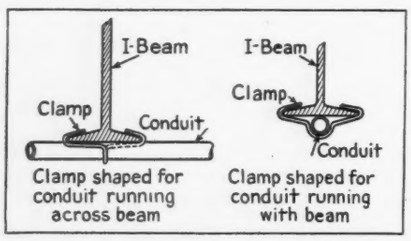
W. D. Bristow.

Washburn Wire Company
Phillipsdale, R. I.

■

## Conduit Hangers for I-Beam Attachment

THERE are a number of conduit hangers on the market, which serve their purpose very well and although they vary in construction, cost, etc., each type has its champions. The type of conduit hanger illustrated is not advocated as being superior or cheaper than




**Improvised hangers for conduit running at right angles to, and parallel with I-beams. Dotted lines in the sketch at the left indicate the portion of the hanger that is bent down in securing the conduit in place.**

the ones on the market, but for odd jobs such as running over exposed steel, will be found very satisfactory. This type will hold the conduit firmly in place.

They are easily and quickly constructed; the size of stock required varies with the size of conduit and perhaps the location of the installation, but I have found that $\frac{3}{16}$-in. round iron is about right for the smaller sizes of conduit. The clamps are shaped in the shop except the one end which is easily bent over the beam when fastening the conduit in place.

Insofar as we know this hanger was designed by Henry Howe, master mechanic, Great Western Sugar Company, where it has been used extensively.

Fort Collins, Colo. J. P. Collopy.

■

## Motor Trouble Traced to Compressor Intake Valve

SOME time ago a local paint contractor was having trouble with the compressor used with his spray-gun equipment. The man operating the outfit complained of fuses blowing. We replaced the blown fuse links, and the switch was thrown in with the same results. The condulet cover was removed from the motor lead box; the connections untaped, and the motor thoroughly tested for opens, shorts, and grounds. Everything tested clear, but the motor refused to start under load.

When all these tests were completed we decided that the motor was in good condition. We found that it was difficult to turn the compressor fly wheel over by hand. The unloader valve was removed and examined but no trouble was found with it. We next removed the compressor head and found one of the valves stuck. The head was replaced and bolted down tight, but when the motor was started the fuses let go again.

While thinking over the problem I absent-mindedly removed the cap from the compressor intake. The motor was started and the machine operated smoothly. The cap was replaced on the intake and the motor immediately slowed down again.

It was evident that the intake cap was the cause of the motor trouble. A thick felt washer was used in this intake cap to strain the paint and dust from the air. This washer had become clogged up with paint, which when removed permitted the motor to run satisfactorily.

Grady H. Emerson.

Birmingham, Ala.

■

## Zinc Blocks to Correct Corrosion in Tanks or Coolers

WHEN sea water is used in coolers or tanks a galvanic action sometimes is set up, causing corrosion of the steel plates. This action can be prevented by hanging zinc blocks in the tank or cooler.

The blocks should be attached so that good contact is made with the body of the vessel. Make a $\frac{5}{8}$-in. stud from 1-in. square bar stock. Screw one end into the shell of the tank. Drill the zinc block, slip it over the other end of the stud, and fasten by means of a nut.

Arcadia, Calif. M. C. Cockshott.

■ ■

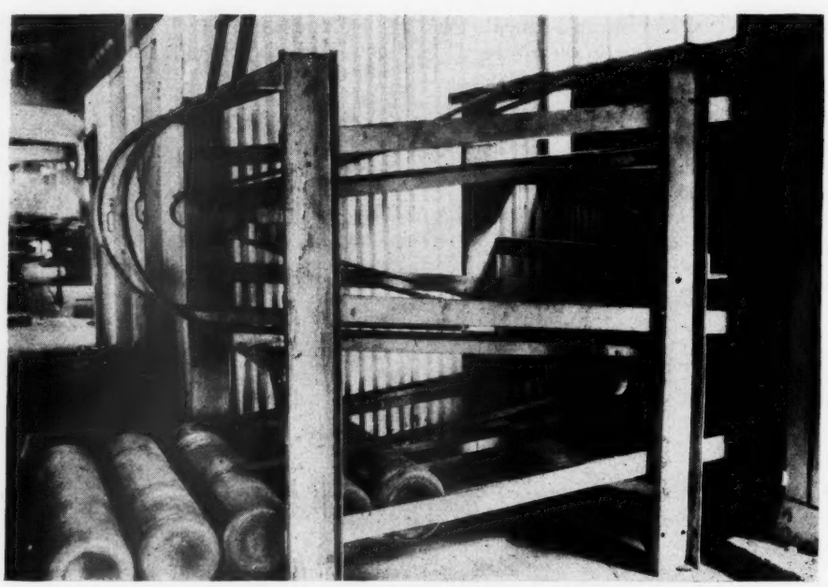
## From Truck to Storage in One Operation

SAFETY in unloading and storing gas containers are features incorporated in the device shown, which is in use by a consumer of large quantities of gas used in welding.

As the containers are delivered by trucks, they are rolled through a slot cut into the building wall, entering the runway which is graded to lower them to almost floor level. Brakes in the form of steel strips bear down on the containers in proceeding along the runway to retard the speed of descent. Delivery from the trucks to storage is made without additional help from the plant.

Shipments are made in quantities not to exceed the capacity of the rack which is large enough to hold approximately 20 tanks. With tanks stored in this manner one can tell at a glance the quantity of gas in reserve.

Sufficient clearance is provided to enable those handling the gas to use a crane from this point to the point of utilization within the shop.



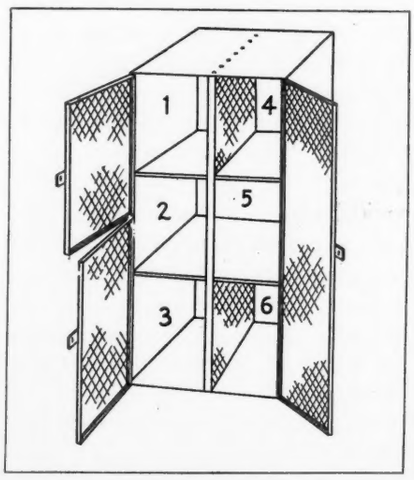
**From truck to storage in one operation. With the weight of the cylinder and the pitch of the runway the movement is always toward the point of withdrawal.**

## Utility Locker for Shift Engineers

NOT long ago I planned lockers for three shift engineers, one of whom was always on duty as the plant operated 24 hours a day—three shifts of 8 hr. each. The sketch shows how it was worked out, so that the chief engineer could occupy the right half and each of the other two men could use one section of the half on the left. Each man has a private section for his personal effects but he also has access to a portion of the locker where company material such as oil cans, spanners, waste, etc., is kept.

Thus the chief has for his private effects, section *4*, while section *6* is for the company records he keeps. He has access to the spanners, oil cans, etc., which are stored in sections *2* and *5* which is really one section. When he goes off shift he locks his door.

The second engineer has compartment *1* for his tools, etc., but also has access to compartment *2* as the lower part of his door allows him access to this compartment. Likewise the third engineer has compartment *3* for his personal effects and has access to compartment *2* and *5* as his door when opened, allows the lower half of compartment *2* to be entered.




**Locker for three shift engineers.**

Each man can have a part of the locker for his personal use and still have access to the middle compartment.

CHAS. A. PETERSON.
Chief Electrician
Cold Spring Granite Company
Cold Spring, Minn.

■

## Spray Head Deflectors Prevent Enamel Spoilage

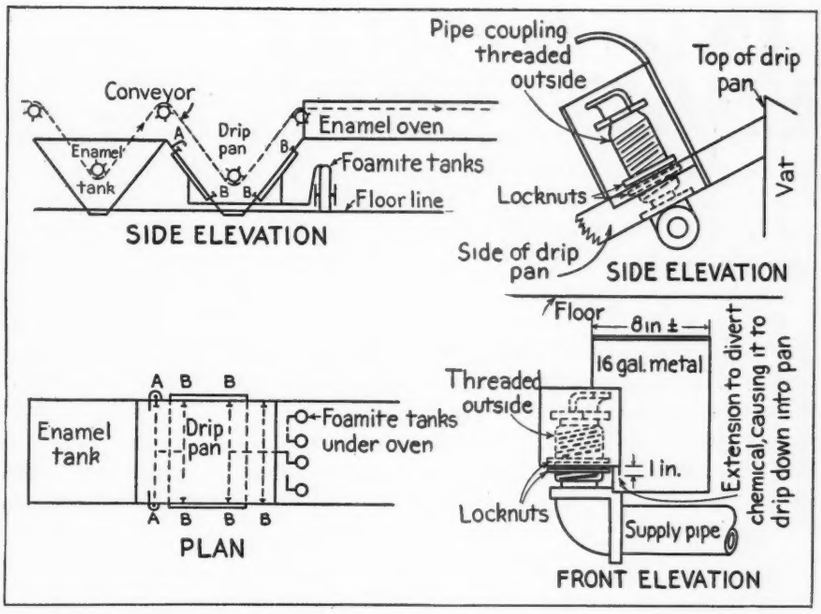
OFTENTIMES fire from gas-fired baking ovens flashes over to material in transit from enameling vats, a condition that is to be expected but not entirely responsible for the spoilage of the enamel in the vats in case the fire goes that far. Generally, the cause of spoilage is the contamination of the enamel by certain chemicals employed in extinguishing the flames.

In one automotive plant, protection against spoilage from chemicals used to fight fire was provided by means of deflectors on the spray heads, which confined the chemicals to the drip pan. The accompanying sketch shows the relative location of the units.

With from 3,100 to 7,600 gal. of enamel in the tank it is readily apparent that spoilage represents quite a loss. The tanks containing the fire-extinguishing chemicals are placed under the oven and are connected to the spray-head piping by means of hose. The supply pipes connect with the nozzles *A* and *B*, as shown.

In case of fire the chemical is automatically released, spraying the material in transit over this drip pan. The excess chemical simply drains into the drip pan.

Flint, Mich. G. R. WILSON.




**Views of equipment layout and spray heads equipped with deflectors to prevent chemicals used in fire fighting coming in contact with enameling mixture.**

■ ■

## Making a Glass-to-Metal Joint Leakproof

LEAKAGE at joints of glass sight tubes used for water or oil level determination is easily prevented or stopped when the following simple and inexpensive method is employed.

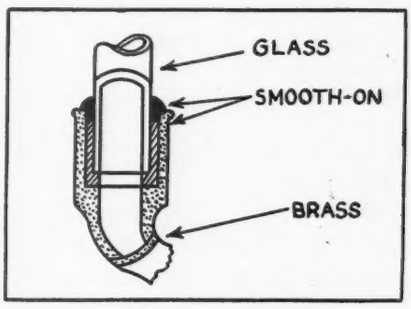
First, insert common cotton twine packing in the gland around the glass, as shown, calking it firmly in place until it is within a short distance from the end of the gland.

Second, take a small quantity of Smooth-on No. 3 Iron Cement and add enough water to bring it to a putty-like consistency. Force this mixture into the space between the glass and the metal wall, on top of the packing, building it up slightly around the glass and over the top of the gland.

Inside of an hour the gage can be put into service without danger of leakage. This method of leakproofing was applied to the oil-level sight feed glasses on a 50-hp. motor, from which the oil had been drawn out of the bearings and into the motor windings with subsequent disastrous results.

Before proceeding as indicated, however, the surfaces were sandpapered and thoroughly cleaned. As a result of this treatment, the motor has been in use every day for the past three years.

CHARLES R. WHITEHOUSE.
Standards Engineer
The Holtzer-Cabot Electric Company
Boston, Mass.




**A type of leakproof joint used on motor bearings sight-feed oil gages. A cement mixture is used in addition to the cotton packing.**

# INDUSTRIAL ENGINEERING

L. C. MORROW, *Editor*

Vol. 89 MARCH, 1931 No. 3

**Don't ignore the amazing power of the new technology. No peril is quite so disastrous in business these days as a smug, self-satisfied assurance that present technique in production will be permanent. Our engineers, our chemists, our inventors, have never shown such relentless zeal as at present. They have largely been responsible for lifting the country out of every preceding crisis. Those industrialists who cling closely to them right now will have good reason to be thankful.**

**Don't overlook the perils of obsolete equipment. It is wiser to have the junk heap outside the factory than in it. Nearly half the machinery in our American factories today is over ten years old. The paralysis of advancing senility is all the more dangerous because its stealthy approach is so painless, so easy.**

**DR. JULIUS KLEIN**
***Assistant Secretary of Commerce***

## The Supplement to This Issue Offers "A Platform for American Business"

WHAT is American business going to do about the depression? About preventing future depressions? Specifically, about policies for the year 1931?

Nobody is certain. About all anybody knows is that business is thinking harder, and probably straighter, than it has thought for years. It is receptive to policies that it can consider sound. It is open to suggestions.

A proposed "Platform for American Business" is mailed as a supplement with this issue of *Industrial Engineering*. The platform has been constructed by the McGraw-Hill Publishing Company in an attempt to do its part, and to stimulate others to do their parts, in meeting the challenge of the future.

Few, if any, of the proposals made will in any way shock business. Most of them have been discussed by economists and other business leaders from time to time. Yet, assembled as they are, they focus attention upon certain important, constructive steps that can be taken. The platform is an analytical summary of economic principles as they can be applied to the present situation.

The average man who goes to a plant job each morning and leaves it each night does not have much to say about what business policies shall be followed. But he does want to know what problems are facing the business leaders and the probable direction that the thoughts of these men will take. He will find out by reading the platform.

He will find, also, that he can be of help in sustaining the platform by accepting a sane view of such matters as labor relations, modernization of plant and equipment, efficient maintenance, and low-cost production. He can become a stockholder in the platform, and work with the objective of increasing prosperity dividends, just as he now works for increasing direct industry dividends if he is a stockholder in the industrial concern that employs him.

## Mark Calendar — Make Reservations for Industrial Congress

NEXT month the intensive activities of several engineering societies will culminate in the second National Industrial Congress in Cleveland.

Every engineer interested in management, maintenance, or materials handling is advised to attend. The congress will be educational—will furnish much information directly usable in industry's efforts to obtain greater *net profit.*

Of especial net-profit value to readers of *Industrial Engineering* will be the maintenance sessions. The function of maintenance is old in years but comparatively young in recognition. So ten papers in three sessions devoted entirely to maintenance is a veritable feast for maintenance engineers. The diet is balanced—there will be nothing but growth as after-effect.

The exposition of equipment, too, will be fine food for engineers who are helping their plants increase net profit. The exhibitors are showing their equipment in order to build up sales, naturally, but the manufacturer of today knows that he can't sell unless his equipment will have a beneficial effect upon his customers' net profits. He is not selling a fur piece on a side street. Spend a liberal amount of time with him.

## Modernizing With Obsolete Equipment

WITH the necessity for and the advantages of modernization so clearly brought out as they have been recently, the selection of any new equipment takes on greater significance and becomes a matter worthy of close attention from a standpoint that may sometimes be overlooked.

True modernization is not always attained merely by the installation of equipment that is new, when judged solely from the date of manufacture. Control equipment forms a case in point, although the same principles will apply to many other kinds of apparatus.

There has recently been a good demand for cheap, manually-operated motor switches, which the manufacturers have had to satisfy. Thus far, everyone concerned can be presumed to be happy. However, the fact that many such switches have been sold apparently indicates that some plants that are rehabilitating equipment and facilities are not taking full advantage of the benefits that modern push-button control offers.

Manual control has a legitimate place in many applications. Under certain conditions wherein its natural limitations do not weigh too heavily, its use is justifiable. Today, however, control equipment is called upon to meet requirements and fulfill conditions that were virtually unheard of and impossible to accomplish a decade ago. Designing skill has accordingly produced magnetic control apparatus that possesses many characteristics and advantages that are highly desirable, even though they may not be absolutely essential in every application. To ignore these advantages and revert to, or continue, to use equipment which is inherently inferior to the best that is now available is decidedly not a step forward. It is a step that should be taken only after careful consideration of every factor that enters into the situation.

Equipment, whether it be control or anything else, is not necessarily entitled to be called modern just because it was made last week or last month. From the standpoint of its limitations, as compared with the performance of the latest designs, it may really be obsolete before it is installed.

## All Hail to the Maintenance Engineer!

EVIDENCE there is on every hand that industrial plants in general have heeded the admonition to put their equipment and facilities in the best possible condition, in preparation for the heavier production schedules that are certain to come with the passing of present situations.

There has been a vast deal of painting up, alteration, revision of layouts, and drastic modernization in plants that are blessed with far-sighted management and alert, sound-thinking plant engineers. In such institutions there has been frank recognition of the fact that for some time to come orders for goods will go largely to manufacturers whose plants and methods are efficient enough to enable them to make a profit under highly competitive conditions. It seems fairly obvious that plants which are still lagging behind —trying to meet today's conditions with yesterday's equipment and methods—are going to have some hard, maybe impossible, sledding.

The year that is past has been, for many, a soul-testing period with a full measure of struggle and disappointment. Just what the new year will bring is still ten-twelfths conjecture. Nevertheless we may have the comforting reflection that today a great many industrial plants are cleaner, more efficient, and in better shape generally than they were a year ago. That fact not only augurs well for our future prosperity, but stands as a proud record of achievement on the part of maintenance engineers.

## Employees, 500—No Lost-Time Accident in 484 Days

SAFETY PROBLEMS, like death and taxes, are with us always. Despite all the efforts that are being made to reduce deaths and injuries due to industrial accidents, the yearly toll in maimed bodies, wrecked lives, and money, is appalling.

Dark as that side of the picture is, the fact that real progress is being made is clearly apparent from the record hung up last year by the Universal Atlas Cement Company, a subsidiary of the United States Steel Corporation. With more than 500 employees and a producing capacity of nearly 20,000,000 sacks of cement a year, this plant operated throughout 1930 without a single lost-time accident. In consequence of that achievement this company has the distinction of being the largest cement plant in the country ever to win the annual safety trophy offered by the Portland Cement Association.

The safety record in this plant is, in fact, even better than it would appear. It is reported that no lost-time accidents occurred after September 3, 1929; hence, the safety record was unbroken for 484 days.

High temperatures in the kilns, massive grinding and pulverizing machinery, extensive materials-handling systems, and the necessity for transporting huge tonnages of materials, all conspire to produce conditions that would lead to many serious or fatal accidents, in the absence of the most modern safeguards and an ever-continuing program of safety education.

Our hats are off to the officials of the Universal Atlas Cement Company and the Portland Cement Association—for an achievement of which the entire industry may well be proud.

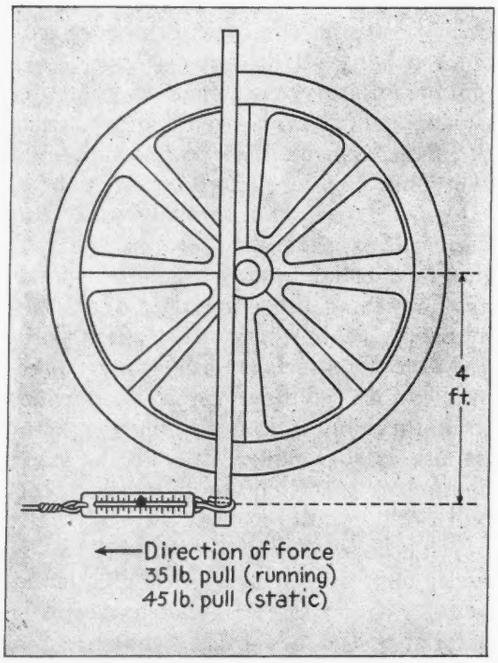
# Motors for High-Inertia Loads

## *Part 2*

*(Conclusion)*

By R. F. EMERSON

*Industrial Engineering Department*
*General Electric Company*
*Schenectady, N. Y.*




**A simple arrangement for determining static and running friction, by means of a spring balance attached to a bar fastened to the flywheel of a machine.**

PERFORMANCE characteristics of the different types of motors in industrial use were discussed in the February issue, with the effect that high inertia exerts during acceleration of the motor. Consideration will now be given to the use of high inertia, in flywheels, for handling peak loads while the motor runs at full speed.

As stated in the preceding article, the energy spent by a motor in accelerating a flywheel is not lost, but is stored in the wheel. When considering flywheel drives, the following facts should be kept in mind:

1. As a flywheel can be regarded as a reservoir of energy, the amount it can give out is limited, and is proportional to its $WR^2$ and the square of its speed.

2. For a flywheel to give up its energy, it is necessary that it be driven by a motor that will slow down when the peak load occurs. A synchronous motor running at constant speed at all loads is not suitable for such drives. A squirrel-cage motor with rotor having the correct amount of resistance, or a wound-rotor motor with permanent resistance in its rotor circuit, will give the proper speed characteristic.

3. As the energy in a flywheel is proportional to its mass and the square of its velocity, a small flywheel at high speed may contain the same amount of stored energy as a heavier wheel running at a lower speed.

In designing a flywheel, the friction and windage losses, cost of heavy bearings, and cost of the heavy flywheel itself must be balanced against the attendant losses of greater speed reduction required of a smaller wheel. With a lighter wheel the speed reduction is greater, necessitating a higher resistance in the secondary of the induction motor. This means a loss in electrical energy, because the greater the average slip of an induction motor, the lower the motor efficiency.

A flywheel of given mass running at given speed contains a definite amount of stored energy; hence, it can handle only peak loads within its capacity. Obviously, there must be sufficient time between peak loads to enable the motor to bring the flywheel back to full speed again.

If a peak load of too long duration occurs, the stock of power is all used up and a flywheel is worse than useless. On the other hand, if the peak-load duration is around three seconds, the stored energy in a flywheel will help the motor carry the load and will make possible the use of a smaller motor than would otherwise be needed. The speed reduction in most cases should not exceed 15 per cent.

Flywheel effect has thus far been referred to as $WR^2$, where W is the weight in pounds and R is the radius of gyration of the flywheel in feet. The radius of gyration of a flywheel is not necessarily its outside radius, but rather is the average radius of all portions of the wheel from the axis of rotation.

With flywheels having a heavy rim, not much error will exist if the mass of the hub and spokes is neglected and the radius of gyration is considered as the distance from the axis to the middle of the rim. The true radius of gyration will be somewhat less than this owing to the effect of the material in the hub and spokes which is at shorter distances from the axis.

A formula for calculating the radius of gyration of a flywheel rim is:

$$R = 0.7071\sqrt{\frac{D^2}{4} + \frac{d^2}{4}}$$ where

$R$ = radius of gyration.
$D$ = outside diameter of flywheel.
$d$ = inside diameter of the wheel.

For example, assume a flywheel having a diameter of 6½ ft. measured to the outside of the rim, with a rim 6 in. square. Then,

$$R = 0.7071\sqrt{\frac{6.5^2}{4} + \frac{5.50^2}{4}} =$$

$0.7071\ \sqrt{18.12} = 3$ ft., the radius of gyration.

The cubic contents of the wheel can be calculated by direct measurement, and the weight estimated by taking

480 lb. as the weight of 1 cu.ft. of iron.

The practical application of a motor to a machine having running friction, static friction, and flywheel effect, can now be shown.

Consider the flywheel, illustrated on page 130, to which a bar is fastened extending an equal distance on each side of the axis so as to compensate for its weight. A spring balance is applied as shown. As the force is gradually increased, the spring balance will show a considerably higher value at the instant the machine breaks away and starts to turn, than it does after the machine starts rotating. This high initial pull is due to the static friction which is so prominent in some types of drive such as long belt conveyors. The smaller force that exists after the static friction disappears is the running friction.

Using the values for force and lever arm given in the illustration, we find that $45 \times 4 = 180$ lb. starting torque required and $35 \times 4 = 140$ lb. running torque. Assume that this machine runs at 175 r.p.m. and is to be gear- or chain-driven by a 900-r.p.m., 60-cycle induction motor having a full-load speed of 870 r.p.m. Then the speed ratio between motor and driven machine is $870 \div 175$, or $4.97 \div 1$. Allowing 5 per cent losses in gears, the full-load running torque required at the motor pinion will be, $T_R = 140 \div (4.97 \times 0.95) = 29.6$ lb.-ft. torque.

When torque is known, horsepower can be calculated by multiplying it by the speed and dividing by the constant 5,250 so that,

Horsepower $= (29.6 \times 850) \div 5{,}250 = 4.8$ hp.

Therefore, a standard induction motor rated 5 hp. will drive this machine at 175 revolutions per minute.

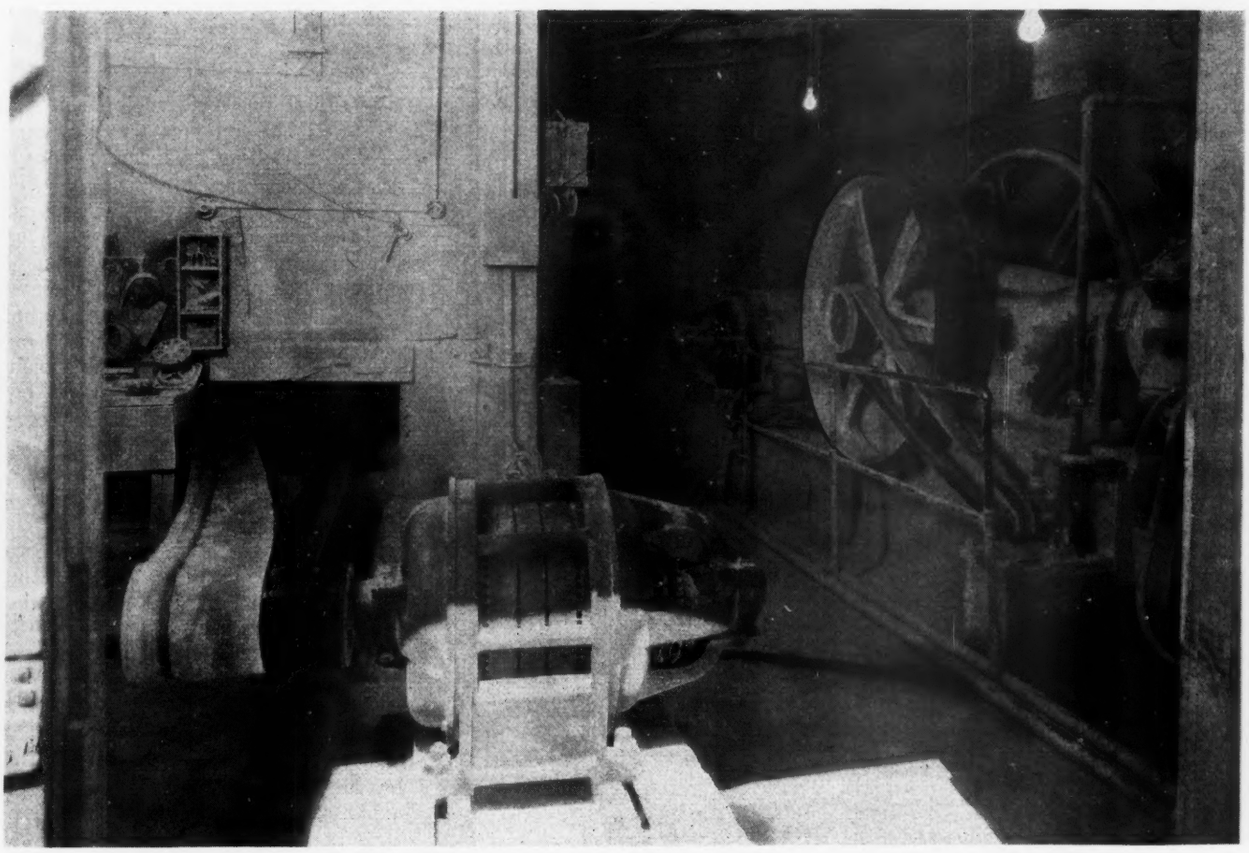
The starting torque required of the motor is calculated in the same way as the running torque:

$T_s = 180 \div (4.97 \times 0.95 = 38$ lb.-ft. torque.

The full-load torque of a 5-hp., 850-r.p.m. motor is found to be $T_{FL} = 5 \times 5{,}250 \div 870 = 30.2$ lb.-ft. torque.

The starting torque required (38 lb.-ft.) is 126 per cent ($38 \div 30.2$) of the full-load torque (30.2 lb.-ft.) of the 5-hp. motor. A general-purpose, three-phase, 60-cycle, 900-r.p.m. (synchronous), 5-hp. squirrel-cage motor can usually be counted on to have 150 per cent starting torque when starting on full voltage and could be expected to start this load, unless the voltage were low. If the starting torque required were found to be much in excess of 126 per cent, a squirrel-cage motor designed for high starting torque, or a wound-rotor motor, should be considered.

If the wheel were rotated at 175 r.p.m. by pulling on the spring balance, it would be found to register an increase in pull while accelerating the machine, but after getting it up to speed, the pull on the balance would reduce to practically the original running pull of 35 lb., plus a small amount for windage. This increase in pull during acceleration is the force of acceleration, and the extra energy expended in accelerating the flywheel is stored in the rotating mass. As it is not practicable to rotate the machine in this manner and read the



**Air compressors require considerable flywheel effect to smooth out the rapidly-recurring load peaks. The compressor shown here is driven by a 100-hp., 900-r.p.m., wound-rotor motor. The motor in the foreground is also of the wound-rotor type, is rated at 50 hp., and drives a rock crusher**

spring balance, the increase in torque will be calculated by the formula

$T_a = (WR^2 \times RPM) \div (308 \times t)$ (1)

where

$T_a$ = accelerating torque.

R.p.m. = change in speed of motor in revolutions per minute.

$t$ = period of acceleration in seconds.

$WR^2$ = total flywheel effect of rotating mass.

308 = constant.

This formula is really the fundamental physics formula of force equals mass times acceleration as applied to the rotating body.

If the $WR^2$ of the rotating mass is found to be 60 lb-ft.$^2$ then

$T_a = (60 \times 850) \div (308 \times 5) =$ 33 ft.-lb.

In other words, it requires an "extra" average torque on the part of the motor of 33 lb.-ft. to accelerate the machine to full speed in five seconds. This 33 lb. is in addition to the 29.6 lb.-ft. torque shown by the spring balance as required to overcome friction, so that during the five-second accelerating period the motor is required to exert an average torque of 29.6 plus 33 = 62.6 ft.-lb.

The torque of a general-purpose, 5-hp.-, 900-r.p.m. squirrel-cage motor can be expected to vary between 45 lb.-ft. at starting and 75 lb.-ft. at maximum: hence, this motor can probably accelerate the machine in five seconds, although the acceleration of the motor's own rotor requires some energy so that the five-second period may be exceeded.

In the case of a drive like a shear the motor carries only the friction load when the machine runs light, but when an operation is performed the load may be many times the friction load. Assume that the friction load is 10 hp. and the peak load lasting for one second is 220 hp., or 230 hp. total. What size motor is required for this drive? As an induction motor can usually be counted on to have a breakdown point of 2½ times its full-load capacity, a 100-hp. motor might handle the load, although it would be safer to use a 125-hp. motor so as to have some margin in case of an occasional extra-heavy peak which might stall a 100-hp. motor, or in case of occasional periods of low voltage, during which the motor torque would be reduced as the square of the voltage.

Assume now that this drive is equipped with a flywheel. How much $WR^2$ should such a flywheel have in order to carry a good proportion of the peak load, which lasts for one second, and thus reduce the size of the motor, and the amount of power taken from the line? As previously stated, it is necessary for the driving motor to slow down when the peak load occurs so that the flywheel can give up its energy. Over its operating range an induction motor can be considered as having a straight-line speed-torque characteristic. That is, if its slip at full load is 6 per cent, its slip at half load is 3 per cent and at 150 per cent load it is 9 per cent, and so on. For greater loads, the slip increases more rapidly. Therefore, after determining the slip-load curve of a given induction motor by actual test, it is necessary only to check the speed of the motor in order to learn what load it is carrying at any time.

Assume that a 75-hp. motor is to be applied, which is the next size smaller motor of standard rating to the minimum size that could possibly be used without a flywheel. This motor can be counted on to deliver easily up to 150 per cent of its capacity when the peak load occurs. Then, $75 \times 1.5 =$ 112.5 hp. This is the maximum load the motor is to carry and includes the 10-hp. friction load. Subtracting 112.5 hp. from the peak of 230 hp. = 117.5 hp., the amount of power the flywheel must furnish at the end of the peak-load period. For convenience, torques and speeds are tabulated below.

1. Motor friction load—10 hp.—893 r.p.m.—59 lb.-ft. torque.

2. 150 per cent motor load—112.5 hp.—819 r.p.m.—723 lb.-ft. torque.

3. Flywheel torque at beginning of peak—220 hp.—893 r.p.m.—1,290 lb.-ft. torque.

4. Flywheel torque at end of peak—117.5 hp.—819 r.p.m.—755 lb.-ft. torque.

At the beginning of the peak, the flywheel carries all the extra load, or 1,290 lb.-ft. torque. As the motor slows down, the flywheel carries less and less load, until at the end of the peak it is delivering 754 lb.-ft., and the speed has decreased from 893 r.p.m. to 819 r.p.m. Assume the average torque delivered by the flywheel during this period is $(1290 + 754) \div 2 = 1{,}022$. This is not strictly correct because there is a change in the retardation rate during the slowing-down process and the flywheel gives up less and less energy as it slows down. Using formula (1) and solving for $WR^2$,

$$WR^2 = \frac{T \times 308 \times t}{\text{r.p.m.}} = \frac{1{,}022 \times 308 \times 1}{893 - 819} = 4{,}255 \text{ lb.-ft.}^2$$

The physical dimensions of such a flywheel should be considered, to determine whether it would be more economical to use a wheel with greater or less $WR^2$ and whether more or less slip should be required of the motor. Also, the peak load of 230 hp. delivered by a motor without a flywheel should be compared with the peak load of the smaller motor with a flywheel. Whether the electrical energy is a byproduct of the industry or whether it is purchased power would also have a bearing on the final answer.

It should be stated that there has been a tendency during the past year to abandon the use of flywheels for shears. Several installations were made using d.c. motors which start and stop when each cut is made. This method eliminates the use of a mechanical clutch, but it can be used only on power systems sufficiently big to absorb the peak load. One installation uses two 200-hp. d.c. motors and the shear is designed to cut simultaneously three 8x8-in. steel blooms. The shear can make fourteen cuts a minute, starting and stopping for each cut.

■

## National Standard Belting Specifications Being Prepared

WORK on the development of national standard specifications for leather belting has been approved by the American Standards Association, it was announced recently at the association's headquarters. The general adoption of national standards for belting would result in savings of several million dollars annually, according to estimates based on the experience of industries in which such specifications are used. Work on the project will be undertaken immediately by a technical committee of manufacturers' representatives, distributors, large industrial users, and government departments. The American Society of Mechanical Engineers will direct the technical work of the committee under the procedure of the American Standards Association.

The initial task will be an attempt to unify existing specifications for vegetable tanned leather belting into one which will be nationally acceptable to the various industries, so that the benefits of standardization will be available to both large and small purchasers. The committee's work will include consideration of raw material, construction, marking, and physical and chemical tests.

# INSULATING INDUSTRIAL ROOFS

A flexible form of insulation being installed over concrete deck. Where the deck is constructed of wood the insulation may be nailed in place and the mopping to deck eliminated.


H. S. JACOBY

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FOR many years the comparative value of certain types of roofs from the heat insulating viewpoint has been universally appreciated. For example, we were aware of the protection afforded by the wood roof as compared to corrugated iron. It is only within the past few years, however, that insulating materials used in conjunction with the main roof deck have been developed and their value known. Today the wide-awake executive gives considerable thought to the insulation of his roof when planning new construction.

Results to be accomplished by roof insulation are classified as follows:

1. To reduce heat losses and consequent fuel consumption and the amount of radiating surface required.

2. To maintain fairly even temperatures inside the building and consequent comfort to workmen.

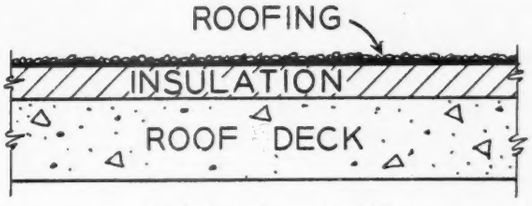
3. To prevent condensation, with deterioration of building and contents.

It is generally admitted that in cases of high humidity—90 per cent or more—and also live steam atmospheres, definite results cannot be controlled by insulation alone. Adequate ventilation, also, must be employed.

The various insulating materials function largely in proportion to the minute air cells which they contain. Consequently the insulating value decreases as the specific gravity of the material increases. It is important, however, that the material be rugged enough to withstand the rough treatment to which it is often subjected during erection.

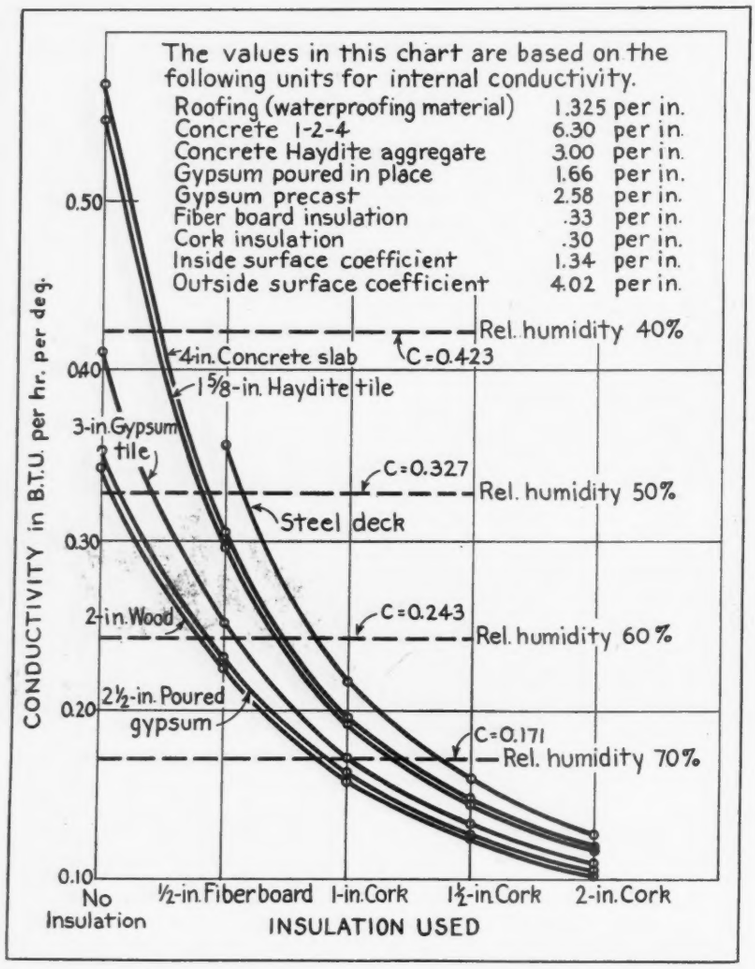
All insulation must be protected against wetting, before, during, and after application. No insulating materials are waterproof. The air in the minute cells is readily replaced by water vapor, a gas, which later may condense into water. Since insulating materials in common use average by volume 75 per cent air and 25 per cent solids, and since water conducts heat fourteen times better than dry air, one can appreciate the futility of wet insulating material. For each one per cent gain in weight from wetting the thermal conductivity of the material increases about 4 per cent.

Insulating materials for roofs are divided into four general classifications: the rigid board type; the semi-rigid board type; the flexible, felt-like sheet type; and the cast-in-place or cellular type. I am inclined to dismiss the last-named from serious consideration for the following reasons: Placed on the roof deck in a wet condition, it requires considerable time to dry out sufficiently to offer a satisfactory base for the roof waterproofing: during this time the material is unprotected from inclement weather, which may continue to keep the insulation wet. The material when set is likely to be rather fragile




Typical roof construction.

THERMAL CONDUCTIVITY FOR VARIOUS TYPES OF INDUSTRIAL ROOFS WITH AND WITHOUT INSULATION. GRAPHS INDICATE CONDUCTIVITY OF THE ENTIRE ROOF CONSTRUCTION INCLUDING WATERPROOFING




**To prevent condensation select roof construction and insulation below the horizontal line corresponding to relative humidity expected based on inside temperature 70 deg.—outside temperature —10 deg.**

| Approximate Values for Relative Humidity | |
|---|---|
| Normal heated factory | 20-40 per cent |
| Printing plant | 45-50 per cent |
| Rayon mill | 45-65 per cent |
| Cotton mill | 60-65 per cent |

under traffic and offer little resistance against roofing fractures. The insulating value is about one-third that of the other two types.

Included by the rigid board type are such materials as the various fibrous insulating boards. They are made by compressing wood, sugar cane, or other vegetable fibers, with or without binder, into large sheets usually about ½ in. in thickness.

Cork represents the semi-rigid type.

Flexible types of insulation suitable for roofing purposes are made from fibrous materials such as waste flax or combinations of flax and rye formed into a felt-like structure ranging from ½ to 1 in. in thickness.

The insulating value of any material depends upon the thickness and the thermal conductivity of the material. The customary measure of conductivity is the amount of heat, expressed in British thermal units, which will flow in one hour through a layer of the material 1 in. in thickness and 1 sq. ft. in area when the temperature difference between the surfaces of the layer is 1 deg. F. The thermal conductivity is a definite physical property of the material which can be accurately determined. It is important to see that the material is manufactured to meet the standards specified, that it is not subjected to abuse during construction, and that it is kept dry, or the actual insulating values will fall short of the published units resulting from tests.

The U. S. Bureau of Standards has determined and published thermal conductivity values for practically all commercial forms of insulation and in various densities. It is interesting to note that no great difference exists in the values of the various materials normally used for roof insulation. The average thermal conductivity of the flexible fibrous materials is approximately 0.28, the semi-rigid cork board 0.30, and the stiff insulating boards have values about ten per cent higher. In general, the lighter the material per unit volume the better the insulating value per inch of thickness.

As far as insulation values are concerned, the problem before the engineer is not to select the proper material, but rather to determine the correct thickness. With the tables now available the heating engineer can compute the economical thickness of insulation to use but he must remember that the real cost of the insulating material is not the cost per square foot of material, but rather the cost per unit of insulating value.

It can be said truthfully that there are few buildings of an industrial character on which roof insulation cannot be used with economy. The savings effected depend, however, upon several factors, such as geographic location of building, type of occupancy, and nature of structural roof deck.

In cold climates the savings in fuel and radiation effected through the use of insulation can be definitely established. As the outside temperatures become more moderate it can be demonstrated that a reduced thickness of insulation with a reduction in insulating value and also a lower cost is warranted. In our southern states insulation may not be economical from the standpoint of fuel saving, but is valuable to keep heat out and hold a more even inside temperature. This is particularly true in the case of offices where the ceiling forms the roof deck itself.

In warehouses, for example, where the inside temperature is not important, roof insulation is not justified. Foundries and forge shops with considerable heat generated by equipment and furnaces do not require insulation. With their customary corrugated iron wall and roof construction and other details which are far from tight, the additional cost of roof insulation would seem inconsistent.

Published tables indicate the thermal conductivity of various roof deck materials. On the accompanying diagram I have plotted values of thermal conductivity or rate of heat transfer for six types of roof with varying amounts of insulation. The entire roof construction has been taken into account, including the waterproofing membrane, with due consideration to the inside and outside surface coefficients.

The analysis of heat flow through a built-up roof section involves three items: First, the flow of heat from the air at the underside of the roof to the lower surface of the roof deck; second, the flow of heat through the various materials of deck, insulation, and waterproofing, which are assumed in direct contact throughout; third, the flow of heat from the exposed surface of the roof to the outside air.

The rate of heat transfer from air to surface, or vice versa, is referred to as the surface coefficient and depends upon the nature of the surface and the state of motion of the air. For most materials used in roof construction the effect of differences in character of surface is slight. Movement of the air, however, increases the surface coefficient considerably and must be taken into account.

The air within the building may be considered still and the surface coefficient for the average material is 1.34 B.t.u. For the outside surface, it is the practice to increase the still-air coefficient by the factor 3 to allow for moving air conditions, which is approximately equivalent to a wind exposure of 15 miles per hour. Thus, the surface coefficient for the outside of the roof construction becomes 4.02 B.t.u. per hr. per sq. ft. per deg. F. difference between the surface and the air in contact with it. These surface coefficients have been used in calculating the values on the accompanying chart.

In studying these graphs, it must be remembered that the effectiveness of the roof from the insulating standpoint increases as the conductivity decreases.

Two important principles are readily apparent. First: Insulation in excess of 1 in. in thickness is only about one-half as effective in reducing conductivity as the same thickness of insulation added to an uninsulated roof. Second: When the thickness of insulation exceeds 1 in. the insulating value of the deck construction becomes of relatively minor importance.

The question of condensation is of especial importance when the humidity within the room is comparatively high, either so maintained by artificial means or as the result of processes which develop large amounts of water vapor.

If the building is already in operation the humidity may be determined directly by test. If the construction is entirely new some assumption must be made. In any case, when the proper value has been determined the roof construction may be designed to avoid condensation under the given conditions, by reference to the chart.

The horizontal lines, corresponding to different values for relative humidity, represent the safe upper limit beyond which condensation is likely to occur. For example, if a relative humidity of 60 per cent is expected in midwinter (outside temperature —10 deg.), ½ in. of fiber board insulation will be required to prevent condensation on 2-in. wood or 2½-in. poured gypsum; 3-in. gypsum tile, similarly insulated, is above the humidity limit line and would not be safe. One inch of cork insulation would prevent condensation for this degree of humidity regardless of the roof deck construction.

It is usual to assume as the outside temperature a value of 15 deg. above the lowest official recorded temperature for the locality. Thus the chart is directly applicable to areas where the lowest recorded temperature is 25 deg. below zero or higher. In general, for outside temperatures lower than —25 deg. the tendency to condensation would be greater and the humidity limit lines slightly lower than shown.

Also, if the working temperature of the room were 75 deg. instead of 70 deg., the tendency toward condensation would be increased, requiring more insulation for any given humidity condition.

Actually the temperature at the underside of the roof may be as much as 10 deg. higher than at the working level. This does not affect the calculation of insulation to prevent condensation as given in the chart, because the increase of temperature at roof level does not affect the absolute

**Insulation over wood deck. Note the separation into small areas by means of strips of roofer's felt extending through the insulation. Damage from roof leakage is confined to the area immediately under the leak.**

humidity or total water content of the air. Actually the higher temperature results in a lower relative humidity, leaving the temperature of condensation or dew point unchanged.

From 1 to 2 in. of insulation usually develops the proper balance between the added cost for the structure and the saving in fuel. In a few cases, where less than 1 in. of insulation might be indicated, it will be found that the full inch will be an equally good investment. In addition, the added thickness represents a more reliable and satisfactory piece of work. In general it may be said that over-insulation is not as likely from an economical standpoint as under-insulation.

Wood roof decks 2 in. or more in thickness, and gypsum roof slabs, either precast or poured in place, possess considerable inherent insulating value. They require insulation to a less extent than other forms of roof construction. However, these facts do not justify the arbitrary statement that insulation may be omitted from wood and gypsum roofs in all cases. On concrete roofs of the usual thickness, and in the case of concrete tile, a decided advantage in favor of insulation is the rule. Where the roof consists of flat steel sheets forming the so-called "steel deck," insulation is essential, not only to reduce heat loss in winter and discomfort in summer but to act as a medium for the waterproofing membrane which would otherwise break with the expansion and contraction of the sheet metal.

In many cases the roof deck construction permits penetration of air from below. This condition requires that the thickness of insulation provided be sufficient to prevent condensation without taking into account any insulating value of the roof deck material. Otherwise, moisture-laden air may reach the upper side of the roof deck, encounter a temperature below its dew point, and condense in appreciable quantities on the upper surface of the deck. In the case of wood roof deck, this condition is occasionally met with due to the shrinkage of the plank and circulation of air through the open joints.

The accumulated water on the surface of the plank rots them out from above and eventually results in total failure. Even though an owner hesitates to increase his investment by purchasing roof insulation and endures the higher heating bills during the winter months and tolerates the occasional dripping due to condensation, he cannot afford to renew his entire roof deck due to recurrent moisture.

As previously pointed out, all forms of roof insulation not only lose their value but also are subject to disintegration when saturated with water. The permanence of the insulation, therefore, depends to a great extent upon the character of the waterproofing membrane provided for its protection. Sometimes the life of the waterproofing membrane is limited by the durability of the insulation which must be considered as the foundation upon which the waterproofing rests. Suitability as a base for roofing membrane has always been an important consideration in roof insulation practice. Where failures have occurred it has been difficult to determine whether the insulation failed because of shortcomings in the roof covering or whether the roof covering failed because of disintegration of the insulating layer.

When properly installed and thoroughly dry, the rigid insulating boards of a fibrous nature provide a firm and generally satisfactory base for the reception of the waterproofing.

Semi-rigid cork board insulation, made by compressing granules of pure cork into molds, has been used as a roof insulating material for many years. It is generally accepted by roofers as a suitable base for roof waterproofing. Under average conditions roof coverings over cork will carry the same guaranty as on wood or concrete decks. Personal observation of the performance of this particular insulating material over a number of years leads to the conclusion that it may be used with entire safety under a first-class waterproofing membrane. Cork board is furnished in blocks 1 or 2 ft. wide, 3 ft. long, and from 1 to 4 in. in thickness. In the manufacture of the block no binder is required to hold the granules together, because the natural gums of the cork serve this purpose. The individual blocks are sanded to true lines and dimensions by the manufacturer and therefore can be fitted tightly together. Any opening remaining at the joint is swept full of granulated cork prior to the application of the roof. With this type of workmanship there are no grounds for the theory that the insulation value of cork is lost at the joints in the case of single-layer construction without laps.

*(Please turn to page 144)*

**Corkboard is being laid over two plies of roofer's felt because of excessive humidity within the building. Note that waterproofing follows closely behind the insulation to minimize the possibility of damage from inclement weather.**

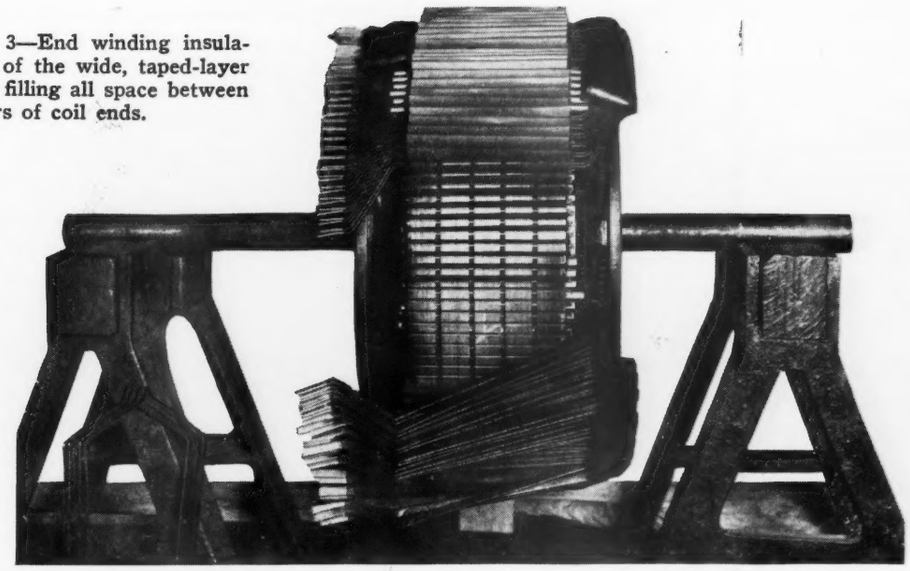


Fig. 3—End winding insulation of the wide, taped-layer type filling all space between layers of coil ends.

# Reinforcing Rotor End Windings Before Banding

By A. C. ROE

*Renewal Parts Engineering Department Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.*

END windings of d.c. armatures and a.c. wound rotors must be restrained from outward or side movement. The method of accomplishing this restriction from movement consists of applying bands of steel wire, under pressure. This band pressure necessitates bracing, padding, and reinforcing the coils and end windings to prevent their collapse, during both the application of the bands and while the winding is in service.

All two-layer windings of the lap or wave type, used in the design of rotating electrical apparatus in recent years, have vulnerable spots that must be protected and reinforced when subjected to pressure or possible chafing. These spots may be in the coils, in the winding, or in both. The location and number of such places depend upon the type of the coil and the winding.

Considering the coils, these may be wound with round, square or ribbon wire, or bare copper strap; in general, the square-wire coil is more substantial and self-supporting. Round wire has a tendency to gutter, and in some cases needs reinforcing strips to prevent slipping or guttering. Ribbon wire wound flat is comparable to square wire, wound on edge; it requires separating strips of cementing and insulating characteristics. Strap-copper coils are generally of one turn wound on edge, but to reduce eddy currents the strap is stranded, transposed, etc., which adds further complications.

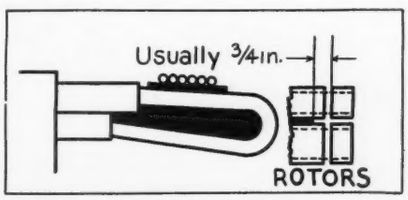



Fig. 1—In Method 1 the space between layers of coil ends is built up solid.

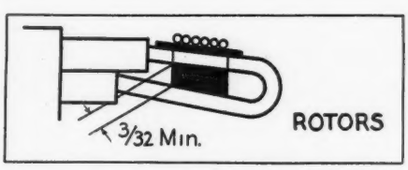



Fig. 2—When Method 2 is used, the space between layers of coil ends, over coil supports, or under bands, is built up solid.

Considering the end windings of any wound rotor, a.c. or d.c., it is obvious that the type of coil and coil supports govern the number of points that need reinforcing. In general these points are: (1) Between upper and lower layers of coil ends as they leave the slots. (2) At diamond points. (3) Between coils and leads wherever they touch or rest on one another. (4) Space between adjacent

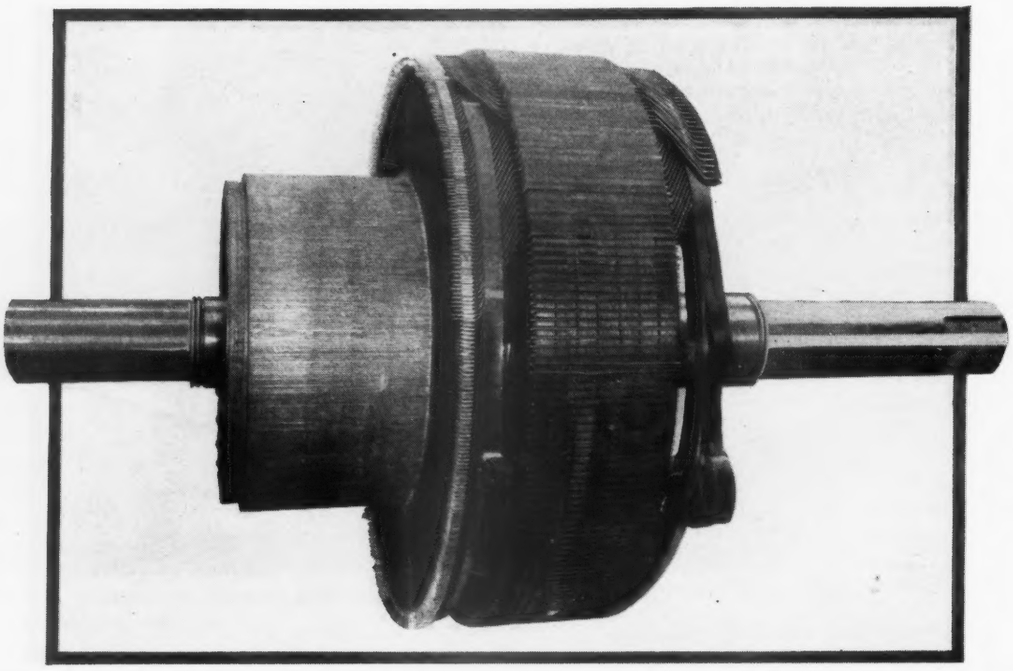


**Fig. 4—Narrow type of end insulation filling the space between layers of coil ends directly under the bands.**

coils. (5) Space between top and bottom layers of coil ends. (6) Between leads where they cross or change planes.

Factory-wound armatures and coils have these points reinforced either by adding insulation to the coils, or by adding insulating material during the armature-winding process. This material is classed as "end insulation winding material." This article will discuss end insulation and its application to prepare and insulate the end winding so as to secure a proper foundation for the end bands.

Armature coils, as previously mentioned, have in some cases incorporated in them various items that are not discernible except by a careful examination of the coil construction and internal insulation. Thus, when stripping any armature it is important to take notes regarding the end insulation as applied to the winding and coils. Generally the items included in the coils consist of filler pieces under finishing tape, taping of turns or conductors, strips of insulating material such as paper, mica, etc., between turns or layers, and so on.

End insulation between layers of coil ends consists of many forms and combinations of materials. In all cases the object is to provide a wall of insulating material of suitable characteristics, shape, and thickness that will not only separate the layers of coil ends, but keep the upper layer from sagging or compressing to a smaller diameter and thus prevent the adjacent coil ends from arch binding before the coils are pulled down on to the coil supports, or to the required finished diameter.

The materials generally used for end insulation are: treated duck, treated asbestos, treated fullerboard, mica and fishpaper, sheet mica, fishpaper, friction cloth, and cloth.

There are two methods of applying the end insulation: (1) Filling the space between layers solidly (see Fig. 1). With windings having figure-eight connectors, the end insulation is kept at least ¾ in. from connectors, as shown. (2) Filling the space between layers directly under the bands and over the coil supports, as in Fig. 2. The kind of, and combinations of, materials will vary according to the type of coil, speed, whether ventilated or non-ventilated windings, diameter of armature, and whether class A or B insulation.

With Method 1 treated duck or fullerboard is used. The width of each succeeding layer is cut narrower to step off the finish wall; this is necessary as the space between the layers at the ends of the slot portions of the coils is less than at the rear diamond loop. Fig. 3 shows the wide or solid type of end insulation, made up of four different widths of treated duck; in this illustration the strips are shown thrown back.

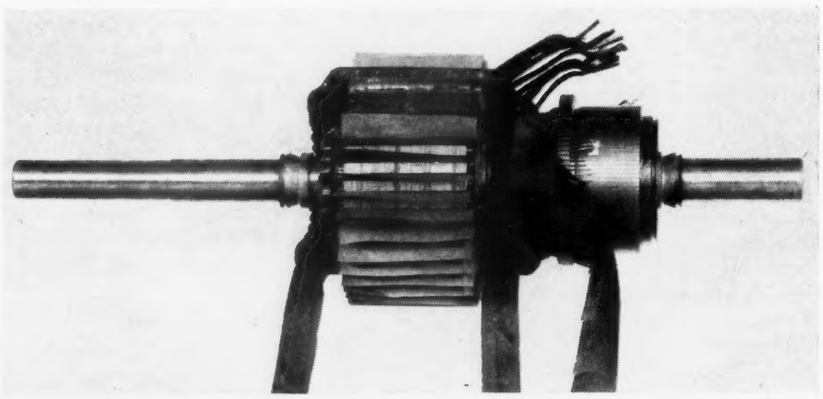


**Fig. 5—An armature with end filling strips preventing arch-binding, to protect the diamond points.**

The narrow type of end winding insulation is shown in Fig. 4. It is composed of several strips of treated duck placed above the coil support.

A single wide strip or sandwich is also used, as shown in Fig. 5, for arch-bound windings without coil supports. Fig. 5 also shows a strip of treated duck applied between the bottom layer of coil ends and bottom leads.

In general, Method 2 (Fig. 4) is used for rotors with strap-copper (rigid) coils and ventilated windings. In most cases the coils have spacing or filling pieces of insulating material taped on the sides of all four coil ends. Method 1 (Fig. 3) is used generally for wire or ribbon coils, strap coils, and non-ventilated windings.

For medium speeds (in revolutions per minute) and class A insulation, Method 1 involves the use of treated cloth and treated fullerboard. For high speeds and class B insulation, three or more layers of mica between two layers of fishpaper are used to fill the spaces up solidly: or, two or more layers of mica and fishpaper incased in friction cloth may be used.

With Method 2, for medium speeds and class B insulation, treated duck or asbestos is used.

When winding rotors having coil supports, care should be exercised to insure that the adjacent coil ends will not arch bind before they are pulled down tightly and snugly against the coil support. This means that the coil supports must be insulated to the proper diameter, and that the filling strips between adjacent coils must not be either too thick or too numerous.

Arch binding can be defined as occurring when a number of coil ends forming a circle are pressed together radially and uniformly until a smaller circle is reached beyond which it is impossible to compress the winding further. Arch binding is an important item in rotor banding and design of coil end windings.

In building up rotor windings there are numerous places that must be protected with additional material to withstand the effects of band pressure, and forces set up during operation. These points will vary and must be checked for, when stripping a factory armature.

Fig. 6 shows an armature with filling strips between adjacent coil ends, and also with small pieces of treated duck at the diamond point of each coil. The type of coil used on this winding has a dropped diamond point and if not properly protected during winding and when banded, short circuits will result between adjacent coil ends. This trouble occurs at the point where the top layer drops down to the second layer, and where adjacent coils cross.

To prevent trouble, coils are designed so as to provide an air space between adjacent coils; then filling strips are applied in these air spaces as shown in Fig. 6, with the result that when properly banded, no coil has been crushed so that it is lower than the others.

This procedure prevents an individual coil from getting loose and causing a short circuit when in service.

It is obvious that rotor windings have features built into them that are of vast importance and that are not apparent at a casual glance. Therefore when stripping a factory-wound armature, check it carefully for all details, and particularly all items of end insulation. If in doubt, consult the manufacturer.

■

## Storage Battery "Dopes"

USE of so-called "dope" solutions for enlivening storage batteries is construed by many leading manufacturers as grounds for the cancellation of battery guaranties. This announcement was made recently by the National Better Business Bureau.

Sold for the past 40 years as substitutes for the standard electrolyte of sulphuric acid and water, these compounds are offered as "battery life-savers," capable of increasing voltage and capacity and doubling the life of batteries. Tests of a variety of the preparations have shown such claims to be "entirely unjustified," the Bureau states. It adds that most of these solutions contain either sulphuric acid alone, Epsom salts, Glauber's salts, or a combination of these as the principal ingredient.

The Bureau of Standards, in refuting claims of the "dope" solution manufacturers that their products charge batteries instantly, reported that the storage battery is not charged by changing the solution.

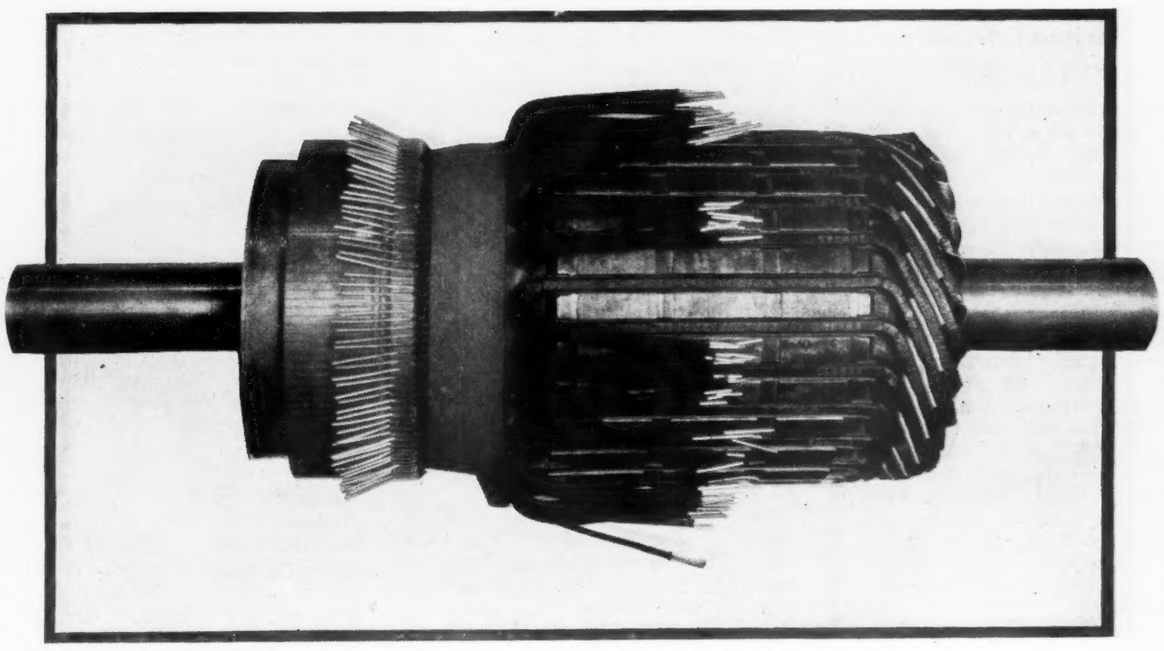


**Fig. 6—Single, wide-strip combination between layers of coil ends that will be arch-bound.**

# QUESTIONS *and* ANSWERS

## Methods of Working Slate

I wish that readers would give me some suggestions on the best methods of cutting and drilling slate switchboard panels up to 2 in. in thickness. It is necessary to make as neat a job as possible, and the work will have to be done mostly by hand, as no special equipment other than a drill press is available. When drilling slate what precautions are necessary to prevent the material from chipping away when the drill comes through?

Albert, W. Va. F. P. H.

■

## Winding Data for Transformer

**Will someone please tell me the number of turns and size of wire to use in the primary and secondary of a transformer that will boost our line voltage from 75 volts to 110 volts? The supply is 60 cycle, and the transformer should be capable of handling an output of at least 400 watts. Any suggestions regarding the best shape and size of the core will likewise be appreciated.**

Rockingham, N. C. **J. W. G.**

■

## How Much Can Belts Be Twisted Without Injury?

**By placing several groups of machines at an angle to, instead of parallel with, the lineshaft that drives them, we can save space. Placing the machines at an angle will mean twisting the belts, which I suppose increases the wear and tear. Our belts are heavy single-ply, oak-tanned, 5 in. wide. Lineshaft pulleys are 30 in. in diameter: the machine pulleys are 12 in. in diameter. Lineshaft speed is 220 r.p.m. The drives are practically vertical. Center distance between line- and machine shafts is about 10 ft. Can readers tell me approximately the maximum angle between the line- and machine shafts at which these belts can be operated without seriously shortening their life or increasing maintenance costs?**

Minneapolis, Minn. **J. Q. C.**

**Please submit answers promptly. We expect to publish no answers later than the second issue following the appearance of the question. Selection will be made on the basis of quality, but answers first received have the best chance of being used.**

## Cause of Hot Armature Bearings

**Out of about 700, 135-hp., 600-volt, street railway armatures there are two that give us much trouble due to repetition of certain defects—badly worn or hot armature bearings. These two armatures are never replaced in the same motor shells, and we have inserted new shafts, put in new coils, balanced them, and so on, but can not overcome the difficulty. These defects have continued over a period of seven years, and we can average only 1,000 car-miles per defect. What is causing this trouble, and how can we cure it?** **C. S.**

Upper Darby, Pa.

QUESTION does not state the type of bearings, or the material used for the bearing surfaces. Presumably they are of the sleeve type, with bronze or babbitt lining. These bearings are generally oiled by means of long-strand wool waste, placed in the housing so as to form a wick for the lubricant. The wool must not be packed in haphazardly.

I suggest examining the armatures closely to see whether the laminations are loose. See whether the disks are defective. Cracks or blowholes in the casting would allow the lubricant to leak out.

If the laminations become abnormally hot, and are mounted directly on the shaft without some means of ventilation, the heat would be transmitted to the bearings. If the bearings are working to capacity any additional heat would be enough to break down the oil film. This point could be checked by determining the motor temperature of some of the other cars.

Heating may be caused by eddy currents, if the laminations have been turned, or the machines have poled on the fields. Readings of current and voltage will show whether these motors are drawing excessive current, which might be caused by an overload due to misalignment or other cause. Thermometers placed in the bearing housings, and one placed so that the internal temperature of the motor may be read, will show whether the motor parts heat up before the bearings. I would recommend a service test of ten hours' duration, with readings taken at about fifteen-minute intervals.

It would be well to put these armatures in a lathe, to see whether the cores are perfectly true with respect to the shaft. When laminations are punched, some sort of mark is made, so that they will all be stacked the same way.

These markings may have been disregarded. See that all of the ventilating ducts are open; otherwise the shaft may be forced to dissipate more than its share of heat.

Put on new pinions, if the same ones have been used right along with these armatures. Check the end thrust. Sometimes shoulders on shafts are placed so that undue pressure is exerted on the thrust surfaces, causing bearings to heat.

If the trouble cannot be found by the repair crew, it would be well to consult the manufacturer of the motors. If he cannot locate the cause of the trouble, it would be cheaper to junk these two armatures, or at least buy new cores.

GRADY H. EMERSON.

Birmingham, Ala.

WITH old armatures that have been in heavy duty and been repeatedly overheated, there is a tendency for the laminations to weld or stick together in places. Such a core will generate more heat than normal, owing to the heavy eddy currents. A large portion of this heat is transmitted to the shaft and bearings.

The remedy in such cases is to dismantle the armature core and dip each lamination in a thin japan or varnish, and then bake or allow to dry. Care should be taken to reassemble the laminations in the order in which they were taken off. MAURICE P. HEIMBERG.

New York, N. Y.

## Corrosion of Water Pipes

**We are having considerable trouble from the rapid rusting out or clogging of the galvanized pipe used in some of our water lines. So far we have used ordinary galvanized iron pipe obtained from a local plumbing supply house. Most of the trouble is experienced with the ¾-in. and 1-in. lines that supply individual machines. We have both hot and cold water lines. The hot water lines seem to deteriorate faster than those carrying cold water. Accurate records of replacements have not been kept, but it appears that the average life of the smaller sizes of pipe is from one and one-half to three years.**

**We do not want to incur the expense of installing brass piping throughout, and I am wondering if there is available any kind of pipe, possibly made from some new iron alloy, that is intermediate in cost and has corrosion-resisting properties between brass and galvanized iron pipe. Can readers enlighten me on this subject?**

**New York, N. Y. W. A. M.**

W. A. M. should have an analysis taken of the water and submit the results to pipe manufacturers for recommendation.

If, as I am inclined to believe, it is due to an acid condition, brass would not be very beneficial. From my own experience I find brass pipe and pipe made of similar alloys will not stand more than 30 days where there is sulphurous acid in the water.

I think he will find that "Toncan" pipe, made by the Republic Steel Corporation, will solve the trouble. Test data show low loss in weight on immersion for 30 days in an acid solution. This pipe can be welded like any steel pipe.

Arcadia, Calif. M. C. COCKSHOTT.

ORDINARY galvanized pipe has a life of from eight to ten years; the life of the pipe in the plant of W. A. M. is only about 20 per cent normal. The product may have something to do with the corrosion if the water is used for washing or draining from the machines. Some form of scale probably is forming in the hot water lines. It collects in the ells or in the pipe runs where the water is least swift. The trouble probably could be reduced or eliminated by the treatment of the water used in the operations.

A suggested remedy is deaerating by the installation of an open tank, or the installation of some device built for that purpose, such as expanded metal which would serve to break up the oxygen. Carbonate of soda will tend to neutralize grease and caustic soda will eliminate oxygen corrosion.

Sherardized pipe might give better service. Some alloy of copper-iron or of brass-iron pipe would be considerably cheaper than brass pipes. It would be a good idea to consult with your supply house.

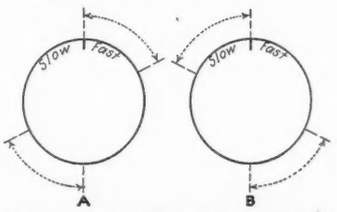
It might also be advisable to have the water analyzed. When deaerating water the oxygen content should be reduced to about 0.4 cc. per liter according to Mark's Handbook. G. H. EMERSON.

Birmingham, Ala.

■

## What Is Wrong with This Synchroscope?

**We have had a G.E. M 3 synchronism indicator in use for six years that has recently given trouble. Our power supply consists of one 750-kva. generator, turbine driven, and one 350-kva., belt-driven generator. Both are 60-cycle, 110-volt machines. When synchronizing, as the incoming machine gets nearly in phase the needle of the indicator**




**jumps past the center mark on the dial. When the incoming machine is slow the needle swings as shown in diagram A; when the machine is fast the needle takes the position indicated in diagram B. It makes two jumps per revolution. I have connected a 50-watt, 250-volt lamp in series with the indicator resistance and the needle does not now jump so fast; the movement from the spaces shown in the diagrams is much slower, but still faster than elsewhere on the dial.**

**I shall appreciate it if someone will tell me how to remedy this trouble. A. H.**

**Selma, La.**

APPARENTLY the cause of the trouble is of a mechanical, rather than electrical, nature. The fact that the action of the instrument is changed when a lamp—which is a non-inductive resistance—is added, strengthens this belief.

It is recommended that the indicator either be returned to the manufacturer, or be taken apart and the bearings thoroughly cleaned and lubricated. These instruments are of such simple construction that the cleaning process can be handled by anyone who has even an elementary knowledge of instrument work. In addition to cleaning the bearings, the collector rings and brushes should be cleaned and made smooth. Be sure that the brushes make good contact. It would also be well to inspect the air gap between the stator and revolving element, and remove any obstructions.

The torque of the indicator during operation is weak at the upper position and if the bearings are sticky, or there are any obstructions, the needle tends to stop at this point.

The jump is caused by a change in the torque sufficient to move the rotating element.

When A. H. discovers the cause of the trouble and remedies it the writer would be glad to know the details.

C. O. VON DANNENBERG.

New York, N. Y.

■

## Rewound D. C. Motor Operates at Half Speed

**We have a 500-volt, 50-hp., Westinghouse Type S No. 10, 825-r.p.m., d.c. motor; the markings on the commutator end of the shaft are: No. 365913—35754—135B—No. 10—S. This motor has four shunt and four series fields. The shunt and series field coils are connected for our line voltage of 250 volts. Recently the armature was rewound, but when it was stripped we failed to check certain connections to the commutator. When reassembled the motor ran at about half speed. So far as I know the turns, size of wire, coil throw and lead throw are the same as before and I should like to know where our mistake is and how to remedy it so that we can obtain the full speed again.**

**Carteret, N. J. W. C.**

TROUBLE with this armature is probably due to the fact that, although the coil and lead spans may be correct, the leads connect to the wrong commutator bar with reference to the slot in which the coil lies. In other words, the brushes are not short circuiting the coil when the latter lies in the zone of minimum flux. This condition can sometimes be corrected by brush adjustment.

Another fault due to careless data taking is spanning too many or too few commutator segments. Most wave-wound armatures connect "one slot under half," as it is expressed. However, connecting one slot over half would do nothing but reverse the direction of rotation.

I suggest that W. C. make sure that the series and shunt fields are free from grounds and all other defects. See that

that the series fields are in the armature circuit. These recommendations also apply, of course, to the interpoles.

If the fields are in good condition and brush shifting does not bring the armature to normal speed, the only thing to be done is to test the armature with a millivoltmeter for wrong connections to the commutator. If too many or too few segments are spanned the test will indicate a series of open circuits around the armature. If the leads have been thrown too far it might be possible to raise the top leads and bring them back to their proper bars. If the leads are spanning too few bars there is practically no remedy except rewinding.

Denver, Colo. CARL A. WAGNER.

■ ■

# The Cover This Month

shows the Bridgeport, Conn., plant of the Sikorsky Aviation Corporation, maker of the amphibian planes bearing that name.

The plant consists of one main factory building of 100,000 sq. ft., an engineering and development building of 40,000 sq. ft., and a service building and hangar of 12,000 sq. ft. These buildings are one story high with the exception of the two office buildings, which are of two stories. One office building is connected to the main manufacturing building and one to the engineering building. The plant covers an area of approximately 10 acres.

Because of the highly flammable nature of the finished product, and the materials used in manufacturing processes, fire protection is one of the chief concerns of the plant engineering department.

All buildings are of fireproof construction, that is, of structural steel and brick. About 40 per cent of the wall areas are of glass with steel sash. The floors are of concrete.

Fire extinguishing equipment includes a complete sprinkler system, 10 2-in. valves with accompanying hose reels located at strategic points throughout the plant, 6 outside hose houses and their accessories, and approximately 40 hand extinguishers of various sizes and types. In the dope room, where plane wings are painted and treated with dope, fireproof doors with fusible links and vapor-proof lighting units are used. This department also contains ventilating equipment consisting of two 30-in. exhauster fans with a combined capacity of about 10,000 c.f.m., and four unit heaters, each with a capacity of approximately 5,000 c.f.m., for supplying air to the room.

Building construction is simple, facilitating maintenance and repairs. Electric wiring and piping are the most modern and are layed out for extreme flexibility. Pipe lines are painted characteristic colors for easy identification. All machines are individually driven and the motors are of the non-sparking induction type.

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# BOOKS

## Industrial Accident Prevention

*By H. W. Heinrich, Assistant Superintendent, Engineering and Inspection Division, The Traevlers Insurance Company. Published by the McGraw-Hill Book Company, Inc., 370 Seventh Ave., New York, N. Y. 366 pages, Price $4.*

PRESENTATION of the simple fundamentals or principles of industrial accident prevention, together with necessary explanatory details is the purpose of this book. The arrangement permits ready understanding, and shows how the control of accident frequency and cost may be obtained in any industrial operation regardless of the size or nature of the work.

All the essential principles of accident prevention, as the author views them, are discussed in the first chapter. Further development of various phases of the subject, the confirmation of certain statements, and specific illustrative examples are found in the succeeding chapters.

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## Corrosion-Resistant and Heat-Resistant Alloys

*Published by the American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa. Price $1.50.*

THE chemical compositions, physical and mechanical properties, and corrosion-resisting properties of corrosion-resistant and heat-resistant alloys are given in this publication, which consists of 11 tables, printed on 17x30-in. paper and fastened into a special 6x9-in. paper binder.

All the commercially available metallic alloys required by engineers are included. The tables are reprinted from Vol. 30, Part I of the 1930 Proceedings of the American Society for Testing Materials. They constitute a revision of corresponding tables appearing in the Symposium on Corrosion-Resistant, Heat-Resistant, and Electrical Resistance Alloys, held in 1924.

The alloys are grouped according to manufacturer, the manufacturers in general being listed alphabetically.

Included within the range of materials are the chromium, chromium-nickel and other special steels, nickel and high-nickel alloys, brasses, bronzes and other copper alloys, aluminum alloys, and so on, representing the standard products of 44 manufacturers.

■

## What It Costs to Have a Clean Factory

*Discussion*

AN article carrying the title given above and published in *Industrial Engineering* of May, 1930, aroused discussion which led the editors to make a survey to obtain statistics relative to the cleaning of industrial plants.

Data were secured from 20 plants manufacturing 20 kinds of products. These plants and products are considered fairly to represent industry as a whole. The survey shows, in the plants reporting:

1. An average of 1.25 per cent of all employees engaged primarily in cleaning work.
2. An average of 2.35 per cent of all employees engaged in part-time cleaning work.
3. An average of 3.6 per cent of all employees doing cleaning work on either full- or part-time basis.
4. An average area of 9,139 sq.ft. per employee engaged in either full- or part-time cleaning.
5. An average floor space of 512,-874 square feet.

Equipment used by these 20 plants includes 14 vacuum cleaners, 11 floor scrubbers, 26 dust blowers, and 3 floor polishers. Special compounds for cleaning floors are used by 75 per cent of the plants; window cleaning compounds by 75 per cent; and special preparations for cleaning equipment by 31 per cent.

The statistics given are of value in furnishing a measuring stick by which any plant can approximate its own cleaning activities.

# Program for 3-M Congress

**Second National Industrial Congress Featuring Management, Maintenance, and Materials Handling to be held in Cleveland April 13-18 in conjunction with the Second National Industrial Equipment Exposition**

UNDER the auspices of several engineering societies a co-ordinated program, featuring Management, Maintenance, and Materials Handling, will be presented as the 3-M Industrial Congress at the Public Auditorium in Cleveland, April 13-18. The second Industrial Equipment Exposition will be held in the Auditorium at the same time.

The American Society of Mechanical Engineers, through its Management and Materials Handling Divisions, is contributing the larger part of the program. The American Management Association is co-operating in the Management program, the Cleveland Electrical Maintenance Engineers Association is co-operating in the Maintenance program, and the Society of Industrial Engineers is taking an active part. Local arrangements are under the auspices of the Cleveland section of the A.S.M.E., Cleveland section of the S.I.E., Cleveland Engineering Society, and Cleveland Handling Equipment Manufacturers' Committee. There are sessions on the elimination of waste, conducted by the Elimination of Waste Committee.

The tentative co-ordinated program, which is almost as it will appear in final form, follows:

### MONDAY, APRIL 13

**2:00 P. M.—Scrap Handling Session**—Club Room B.
Auspices Elimination of Waste Committee (A.S.M.E. and A.M.A.).
"Handling of Thin Sheet Scrap in Tin Plate and Sheet Steel Mills," by H. H. Giles, American Sheet & Tin Plate Company, Monessen, Pa.
"Handling of Automobile Body Scrap," by R. R. Reese, Plant Engineer, Packard Motor Company.
"Briquetting of Cast Iron Borings and Steel Turnings," by A. K. Nowak, Baldwin Southwark Company, Chicago.
Discussion of Handling and Disposition of Ferrous Scrap.

**8:00 P. M.—Waste Elimination Session**—Club Room B.
Auspices Elimination of Waste Committee (A.S.M.E. and A.M.A.).
"Segregation and Control of Waste," by C. H. McKnight, Supervisor Inventory Control, General Electric Company.
"Waste Campaign Experiences and Suggestion Systems" (Short talks giving experiences from several companies).
(Poster Exhibit in Meeting Room. Waste Exhibit in Exposition.)

### TUESDAY, APRIL 14

**8:30 A. M.—Plant Inspection Trips** (From Auditorium).

**2:00 P. M.—Management Session**—Club Room B. Auspices Management Division, A.S.M.E. (A.M.A. co-operating).
"Developments in Manufacture of Lead-Covered Paper-Insulated Telephone Cables," by J. R. Shea, Assistant Engineer of Manufacture, Western Electric Company.
"Planning a Lead-Covered Telephone Cable Manufacturing Plant," by L. C. Hanley, Western Electric Company.
(These papers cover the development and planning of the new Point Breeze, Md., Plant.)

**2:00 P. M.—Hoists and Monorail Handling Session**—Club Room C.
"Monorail Handling of Materials," by C. W. Preston, Majestic Household Utilities Company, Chicago.
"Engineering Factors in the Use of Electric Hoists," by H. J. Fuller, Engineer, New York.
"Bulk Handling Methods for Pipe," by E. W. Burgess, A. O. Smith Company, Milwaukee.

**8:00 P. M.—Drafting Room Management Session—Club Room A.** Auspices Management Division, A.S.M.E. (A.M.A. co-operating).
"Production Management Applied to the Drafting Department," by W. J. Kunz, Combustion Engineering Company.
"Improved Drafting Room Management," by F. O. Newbury, Westinghouse Electric & Manufacturing Company.

**8:00 P. M.—Management Session**—Club Room B. Auspices Society of Industrial Engineers.
"Distribution and Marketing," by Gorton James, Vice-President, Thompson & Lichtner Company, Inc., Boston.

**8:00 P. M.—Standardization in Materials Handling Session**—Club Room C.

### WEDNESDAY, APRIL 15

**8:30 A. M.—Plant Inspection Trips.**

**2:00 P. M.—Conveyor Handling Session**—Club Room B.
"Synchronization of Production Control and Conveyorization," by E. M. Olin, Works Manager, Westinghouse Electric & Manufacturing Company, Mansfield, Ohio.
"Materials Handling for Mass Production at General Electric Plant," by H. C. Rundle, General Electric Company, Schenectady, N. Y.

**2:00 P. M.—Outdoor Handling Session**—Club Room C.
"Handling Equipment for Bulk Materials and Special Purposes," by Arthur F. Case and Paul M. Douglas, Wellman Engineering Company, Cleveland.
"Remote A. C. Controlled Haulage at the Plant of the Trinity Portland Cement Company," by R. F. Emerson, Industrial Engineer, General Electric Company, Schenectady, N. Y.
"Industrial Type of Internal Combustion Engine Locomotive," by S. B. Schenck, Westinghouse Electric & Manufacturing Company.

**8:00 P. M.—Design Handling Equipment Session**—Club Room A.
"Application of Two-Speed Motors to Electric Hoists," by C. E. Schirmer, Robbins & Myers.
"Variable-Speed Transmission for Materials Handling," by D. W. Clem, Reeves Pulley Company.
"Types of Materials to Use in Materials-Handling Equipment," by Harvey Skinner, Boston.

**8:00 P. M.—Management Session**—Club Room B. Auspices Society of Industrial Engineers.
"Skills and Satisfaction," by Dr. Lillian M. Gilbreth, President, Gilbreth, Inc., Montclair, N. J.

**8:00 P. M.—Trucking and Shipping Session**—Club Room C.
"Skids and Skid Shipments," by R. L. Lockwood, New York.

**MAINTENANCE SESSIONS THURSDAY AND FRIDAY**

"Use in Marine Terminals," by H. E. Stocker.
"Use in Railroad Terminals and Stores," by J. B. Miller.
"Handling on Skids," by C. C. Stuber, Manager Industrial Transportation, Goodyear Tire & Rubber Company, Akron.
"The Use of Gas Trucks and Tractors in Materials Handling," by Geo. E. Hagemann, Editor, Alexander Hamilton Institute, New York.

**THURSDAY, APRIL 16**

**9:30 A. M.—Organization Session for Maintenance Engineers**—Club Room C.
"Variations in Maintenance Costs and Procedure," by E. V. Stoody and G. I. Ross, MacDonald Brothers, Boston.
"Departmental Analyses and Wage Incentives," by W. G. Uhlir, Consulting Engineer, Harvey, Ill.
"The Control of Non-Productive Costs," by Harry W. Benton, Plant Engineer, Pratt and Whitney Company.
"Organization and Operation of the Electrical Maintenance Department," by Sidney Watkins, Chief Electrician, Warner & Swasey Company, Cleveland.

**9:30 A. M.—Materials-Handling Session**—Club Room B.
"Automatic Electric Control of Materials Handling," by J. E. Wood, Monitor Controller Company, Cleveland.
"Pneumatic Handling of Vegetable Potash," by J. F. Barnard, Chief Engineer, U. S. Industrial Alcohol Company, Baltimore.
"Handling Small Packages in the Shop," by C. A. Fike, Westinghouse Electric & Manufacturing Company.

**2:00 P. M.—Operating Session for Maintenance Engineers**—Club Room C.
"Maintenance of Electric Cranes and Hoists," by Robt. W. Walton, Shepard-Niles Crane and Hoist Corporation.
"Tools for the Maintenance Engineering Departments," by Thomas A. Keefer, Head Factory Layout Department, National Cash Register Company. Dayton.
"Inspection for Preventive Maintenance," by A. Heckman, Superintendent Works Department, Westinghouse Electric & Manufacturing Company.

**2:00 P. M.—Materials-Handling Session**—Club Room B.
"Use of Rubber Products for Materials Handling," by H. E. Cook, B. F. Goodrich Company, Akron.
"Weighing and Counting Devices Used on Materials-Handling Equipment," by A. B. Jacobus, Fairbanks Company, New York.

**6:30 P. M.—Banquet, National Congress,** all societies participating.

**FRIDAY, APRIL 17**

**8:30 A. M.—Plant Inspection Trips.**

**2:00 P. M.—Housekeeping Session for Maintenance Engineers**—Club Room C.
"Maintenance of an Industrial Illumination System," by R. C. Smith, Western Electric Company.
"Maintaining the Lighting System," by Walter Sturrock, Illuminating Engineer, Nela Park Engineering Department, General Electric Co.
"Paint as Maintenance—Paint as Production," by T. J. Maloney, New Jersey Zinc Company.

**2:00 P. M.—Materials-Handling Session**—Club Room B.
"Handling Bulk Materials Mechanically," by W. W. Sayers, Link Belt Company, Chicago.
"Uses and Application of Portable Belt Conveyor," by J. B. Bray, Vice-President, Fairfield Engineering Company, Marion, Ohio.
"Handling of Materials in Automotive Machine Shops," by N. H. Preble, J. B. Webb Company, Detroit.

All meetings are to be held in the Cleveland Public Auditorium. Members are requested to register for meetings. All engineers and executives, members of participating societies, as well as guests, are eligible to attend. Reduced railroad rate of 1½ fare on certificate plan, contingent upon presentation of 150 proper certificates by members of affiliated societies, has been secured. A banquet and entertainment will be held Thursday night.

The exposition will be open on Monday from 3 p. m. until 9 p. m. On all other days it will be open from 12 noon until 10 p. m.

■■

# Insulating Industrial Roofs

*(Continued from page 136)*

The insulating value of cork board is particularly good. The thermal conductivity is rated by the U. S. Bureau of Standards as 0.30 B.t.u.'s per hr. per deg. per in. It is not water-absorbent and will not swell or buckle under the waterproofing when wet.

Depending upon the construction of the roof, the insulation will either be nailed in place or imbedded in a mopping of asphalt. If in two or more layers, the upper layers of insulation may be nailed to the lower layers or imbedded in further moppings of asphalt. The use of asphalt for the placing of insulation tends to waterproof each layer and to confine any damage from moisture to relatively small areas. On the other hand, the filling of the vertical joints with asphalt lowers the insulating value of the whole.

On wood roof decks the use of one or two plies of waterproofing felt under the insulation is an excellent precaution to prevent moisture from finding its way into the insulation from below. In such buildings as paper or textile mills, where interior air is heavily laden with moisture, base waterproofing becomes a necessity and two plies of roofer's felt should be used. The second ply is mopped to the first with asphalt in the same manner as for regular roof construction under similar circumstances. In general, roofer's pitch may be used instead of asphalt, provided the usual precautions are taken to prevent dripping of bitumen through the deck in hot weather. If the roof deck, as constructed, is reasonably air-tight, as in the case of a monolithic concrete slab, the insulation may be mopped directly to the surface without the preliminary waterproofing course, irrespective of the humidity of the air below.

If leaks develop in the roof covering, the relatively high absorption of the insulation permits the damage to extend for a considerable distance on all sides. It is, therefore, good practice to subdivide the roof area into units approximately 30 ft. square, with each unit entirely separated from the others by a suitable cut-off membrane waterproofing. Two plies of felt well mopped with asphalt are sufficient. As each section of insulation is completed the separating membrane is laid on the top and overlapping the full length of the exposed edge. The felts are then bent down to the roof deck and under the succeeding section of insulation. A similar cut-off membrane should be provided along all parapet walls about 2 ft. out from the flashing, and also on both sides of all gutters and valleys.

Roof waterproofing normally is applied to all forms of insulation in much the same manner as elsewhere. The first ply of roofing felt always should be mopped in place with asphalt or pitch and in some cases nailing into or through the insulation may be advisable. Insulation completed in one day's work always should be covered the same day with at least two plies of the final waterproofing.

# EQUIPMENT NEWS

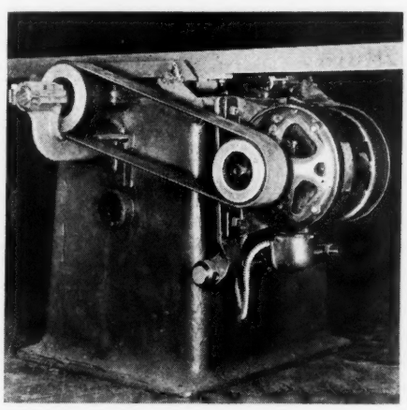
*Industrial plant executives concerned with the selection and operation of mechanical and electrical equipment will be interested in these devices, which are designed to improve plant operation or reduce operating and maintenance costs.*

## Rockwood Short-Center Flat-Belt Drive

SHORT-CENTER, flat-belt drives are now available from stock in sizes from 1 to 50 hp., according to an announcement by The Rockwood Manufacturing Company (Division of General Fibre Products, Inc.), Indianapolis, Ind. The complete drive consists of a motor base, two pulleys and a flat leather belt. The stock drives are designed for 60-cycle polyphase motors of any make.

The motor is mounted on a free-swinging pivot so that its weight maintains a uniform belt tension at all times.

Bases are of all-metal construction and provide adjustments for motor size, pulley alignment, and belt length. Six standard bases cover all size require-



ments for motors from 1 to 50 hp. at 1,800 r.p.m. Units may be mounted on the floor, wall, or ceiling, to drive a single machine or a lineshaft group.

The illustration shows a typical drive on a fiber-cutting saw.

■

## Howell Motor

HOWELL Electric Motors Company, Howell, Mich., announces the development of a motor for use in gasoline vapor and air mixture or lacquer solvent and air mixture. This unit is built in either polyphase or single-phase types with a totally inclosed frame or a totally inclosed fan-cooled

frame. The illustration shows the totally inclosed, fan-cooled frame.

Polyphase motors are of squirrel-cage construction with extra-heavy castings, bolts and parts. All machined parts have large fitting surfaces to correspond with requirements for this class of service.

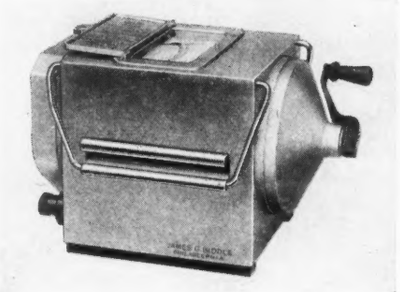
Single-phase motors are also of squirrel-cage construction and are of the condenser start type; each motor having a condenser starting unit placed in a separate box which must be mounted outside the hazardous area.

■

## Biddle "Super-Meg" Insulation Tester

THIS instrument, known as the 1,000-volt "Super-Meg," is intended for use in industrial plants for testing insulation resistance up to 200 megohms at 1,000 volts. Also, it is suitable for testing motors, generators and cables of higher voltage ratings where readings of insulation resistance do not normally run over 200 megohms.

The drive mechanism has a slip clutch



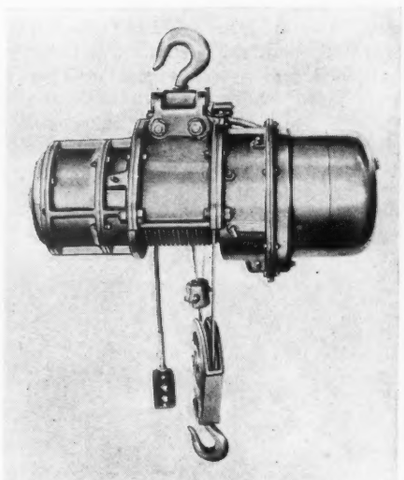
by means of which a constant voltage is generated for the test. The instrument weighs 9 lb., and measures 5½ in. wide, 6¼ in. high, and 9⅛ in. long.

■

## Wright Electric Hoist

DROP-FORGED, heat-treated gears and pinions, alloy-steel shafts and Tru-Lay Preformed Cable are features of the electric hoist introduced by the Wright Manufacturing Company, Bridgeport, Conn. The motors are designed especially for this equipment.

Hoists are arranged for different types of suspension and may be furnished with either push-button or pen-

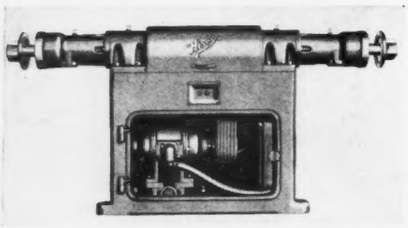


dant-rope control. Motors and controls are dustproof and weatherproof which makes them suitable for both indoor and outdoor use.

■

## Hisey-Wolf Buffing and Polishing Machine

HEAVY-DUTY "Hisey" Texdrive buffing and polishing machines in 10- and 15-hp. sizes have been announced by The Hisey-Wolf Machine Company, Cincinnati, Ohio. Some of the features include unit spindle head con-



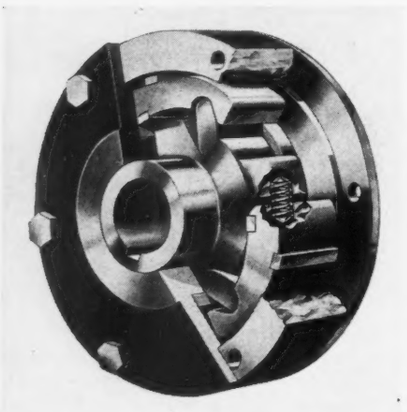
struction; ball-bearing equipped motor, mounted horizontally on a dovetailed sliding base, and adjusted by means of a handwheel and feed screw; Flex-Steel conduit and fittings; spindle head mounted on four ball bearings; a door in the column for easy access to motor and starter; bearing boxes, keyed to column; wheel arbor ends finished with flat-top threads and fitted with Tobin bronze safety wheel nut.

■

## Universal "Pitter" One-Way Clutch

POSITIVE unidirectional drive is furnished by the "Pitter" one-way clutch, marketed by the Universal Gear Corporation, 327 S. LaSalle St., Chicago, Ill. This clutch is instantaneous in locking and releasing action, and is guaranteed not to slip. The greater the load, the tighter the lock becomes.

The unit consists of a central, forged-steel hub on either side of which are two hardened and ground steel races, a hardened and ground outer steel race, and three shoes. Light, helical-coil springs are used to keep these shoes always in position for gripping but the



springs take no part in the drive. If the spindle is rotated in the driving direction, the shoes lock against the inner and outer races, thus giving an instantaneous positive lock at two points on each of the three shoes with no lost motion and no tendency to jam or slip. To increase the wear life, alloy-steel contact members are inserted in the shoes, and the whole clutch mechanism operates in oil. When there is movement of the shoes, there is no load and when there is load, there is no movement, so that wear is negligible.

The clutch is intended to replace ratchets, "no-backs," and over-running couplings. It is particularly designed for converting alternating motion, either reciprocating or rotary, into one-way movement. Clutches range from ½ to 4-in. in shaft sizes. The torque range is from 204 to 124,800 in.-lb. Drive may be through either the outer ring or the hub.

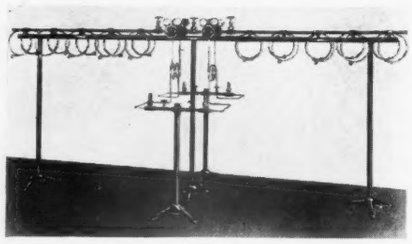
■

## Milburn Twenty-Tank Manifolds

TO eliminate the need for transporting cylinders about the plant, The Alexander Milburn Company, 1416 West Baltimore St., Baltimore, Md., are making twenty-tank manifolds, as shown in the accompanying illustration.

These manifolds are made of bronze tubing, with Milburn standard gas regulators and copper coils.

Each tank or each side of the manifold may be operated independently through separate shut-off valves, thus

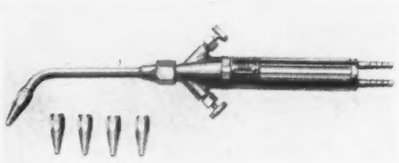


allowing the torches to continue in operation while the tanks are being connected or disconnected.

■

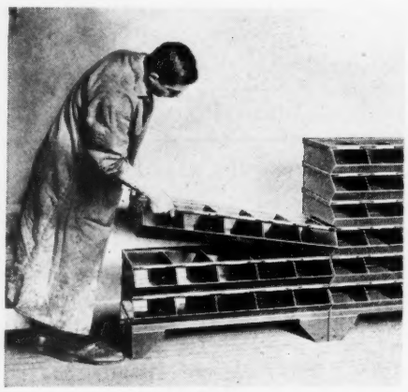
## Linde Welding Blowpipe

TYPE W-107 welding blowpipe for light welding work of all kinds has been added to the Prest-O-Weld line by The Linde Air Products Company, 205 East 42nd St., New York, N. Y. It operates on the medium pressure principle. Gases mix immediately in front of the handle and the oxygen and acetylene valves are located so that they can be adjusted with the thumb and forefinger of the hand which holds the blowpipe. The blowpipe is 10½ in. in length and weighs 10 oz. Six different size tips are available for use, although it is furnished as standard with five tips, No. 2 to 6 inclusive.



## Simplex Metal Bin Sections

METAL bin sections for stockroom use have been introduced by the Simplex Tool Company, Woonsocket, R. I. The sections are designed so that



they can be built up on top of each other much like a sectional bookcase. They are finished in green lacquer and are available in four sizes. Each bin has a cardholder for a description of its contents.

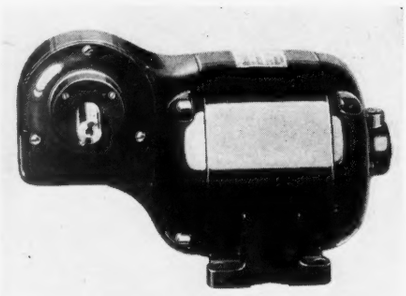
The base shown is separate from the section itself. A top, to serve as a counter, is also available.

Standard bin sections are 37 in. wide, from 12 to 20 in. in depth, and from 4 to 9½ in. in height.

■

## Master "Geared-Head" Right-Angle Shaft Motors

RIGHT-ANGLE shaft motors, so designed that the shaft can be arranged in any one of eight positions, have been announced by The Master Electric Company, Dayton, Ohio. Units with ratios of 8 to 1, 12 to 1, 18 to 1, 24 to 1, 30 to 1, 36 to 1, 48 to 1, 60 to 1, and 72 to 1 are now available.

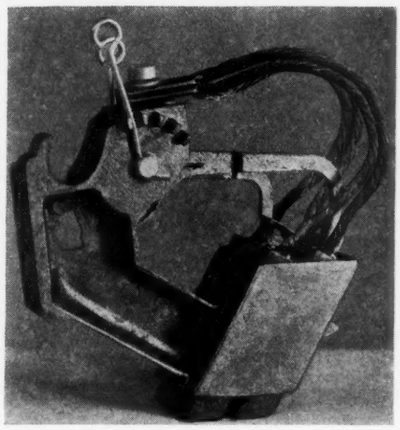


The motors are equipped with anti-friction bearings throughout, with precision ball bearings on the motor shaft and roller bearings on the slow-speed shaft. This construction permits mounting in any position without change in construction.

The worm gear is manganese bronze and the worm is made of high-carbon steel.

## Westinghouse Brush Holder

TO avoid the possibility of sparking between the brushes and the commutator of large-current, electrical rotating machines, a double brush holder



of die-cast construction has been developed by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. Of the two individual brushes in this holder, one or the other is always in contact.

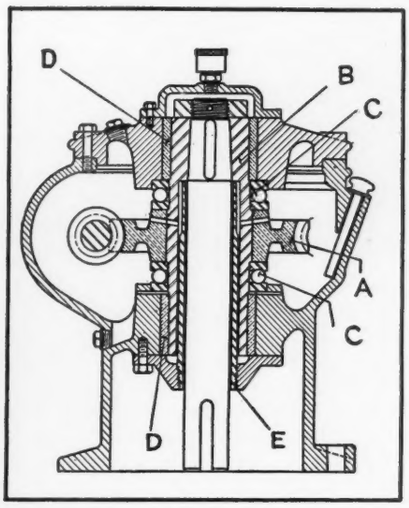
■

## Foote Bros. Vertical Worm Reducer

FOOTE Bros. Gear & Machine Company, 111 North Canal St., Chicago, Ill., announces a vertical, leakproof, "Hygrade" worm-gear speed reducer line designed for use in chemical, paint or food plants, where leakage of oil will contaminate and damage the product.

The cross section cut gives an idea of the means employed to make the unit oil leakproof.

The bronze worm-gear ring *A* is pressed on a splined hollow-steel center *B* and is held rigid on this center by two flat ball thrust bearings *C*. This complete arrangement is mounted on bronze bearings *D* and the hollow center is fastened to the vertical shaft at the uppermost part of the reducer, thus forming a cavity below this point for nearly four-fifths of the entire length of the shaft. In this space is placed a tube *E* which is sealed and fastened to the lower part of the reducer from where it extends upward to a point well above the oil level. At the top, the opening of the tube is covered by the steel center *B*, as shown.




This prevents any oil from leaking out and forms two chambers, one in which the worm gear operates and the other in which the vertical shaft rotates free from contact with oil at all points.

■

## Production Equipment Speed Reducers

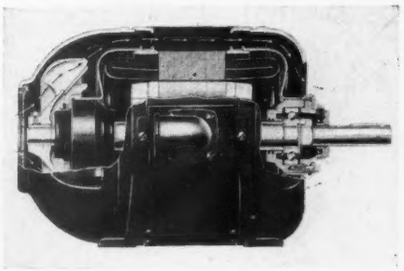
THE Production Equipment Company, Cleveland, Ohio, announces that any of the motorized speed reducers manufactured by them can be supplied with shafts extended at both ends of the unit.

Complete units consist of polyphase induction motors mounted integral with spur, helical, planetary or bevel gears retained in an oil-tight housing. Units with speeds from 20 to 875 r.p.m. on the low-speed shaft are available. The opposite shaft, direct from the motor, provides standard, polyphase-motor speeds of 1,800, 1,200, 900 or 720 revolutions per minute.

■

## General Electric Inclosed Motors

DUST-TIGHT, totally inclosed, fan-cooled induction motors in a complete line have been announced by the General Electric Company, Schenectady, N. Y. These motors are equipped with ball bearings in convenient "cartridge" housings and utilize a single ventilating fan located outside the inclosure proper.



This line provides a totally inclosed motor of the same mounting dimensions, rating for rating, as the standard G. E. open-type, horizontal, general-purpose motor of from ¾ to 50 hp. in standard speeds.

■

## Maehler Oil-Fired Oven Heater

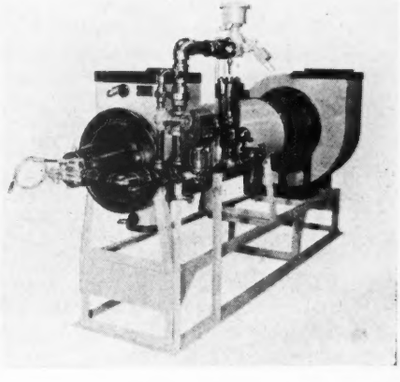
FOR plants using oil as fuel, the Paul Maehler Company, 2208 West Lake St., Chicago, Ill., has developed a unit known as the Oil-Fired Maehler-Universal Heater. In operation, heated air from the heating chamber is forced by the blower at the outlet end of the heater into the oven, creating a slight plus-pressure and providing even heat distribution throughout the oven.

Recirculating air, drawn from the oven at high temperature, is reheated and tempered with a controllable volume of fresh outside air. Explosive vapors are then drawn from the oven and incinerated in the heater instead of being allowed to collect in the oven.

The heater may be located at any desired point above, beside or below the oven, with the control apparatus wherever convenient. The remote control cabinet is equipped with a Bristol temperature controller which regulates the oil flow.

Safety devices close all valves and shut off the power in case of fire or explosion.

Units are available at present in five sizes with an air delivery capacity from 3,000 to 12,000 cu. ft. per minute.

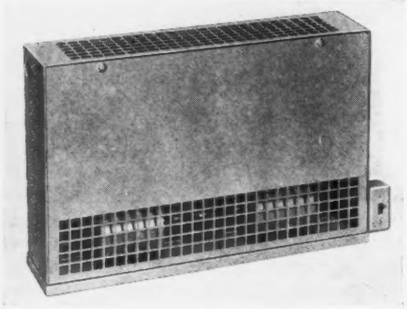


## Dunham-Dwyer Unit Heaters

CABINET-type unit heaters, known as Type M, have been announced by the C. A. Dunham Company, Unit Heater Division, 450 East Ohio St., Chicago, Ill. They may be installed in three positions; floor, ceiling, and inverted wall mounting, or behind walls, breathing air through grilles.

The cabinet is of sheet steel, finished inside and out with baked enamel. The radiator consists of copper tubes, each wound with a continuous copper fin in the form of a helix, which is metallically attached to the tube. At each end the tubes are fastened into semi-steel headers by means of a brass clamping nut which forms a screwed ground joint.

Fans are cast aluminum of the double-inlet, full-housed centrifugal type. Mo-



tors are of the fully enclosed type with dynamically balanced armatures for quiet operation. A toggle control switch is mounted at the side of the cabinet. The motor and fan assembly is mounted in the unit on rubber cushions.

■

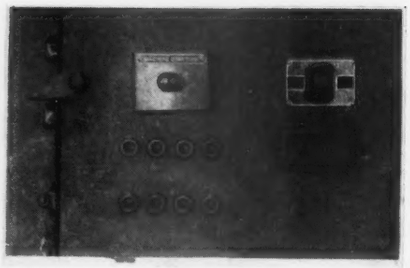
## Brown & Sharpe Depth Gage

DEPTH gage No. 599, for checking the depths of holes, counterbores and distances between shoulders and flanges, has been announced by the Brown & Sharpe Manufacturing Company, Providence, R. I. Depths from 0 to 2 in. by thousandths are obtained by measuring the overall length of the body and rod with a micrometer. From this measurement is subtracted the length of the body which is exactly 1 in. The rods are polished and the body is hardened and ground and has a V-groove which facilitates measuring against a curved surface.

■

## General Electric Switchboard Devices

ADDITIONS to its line of potential and synchronizing plugs and receptacles for use on switchboards have been announced by the General Electric



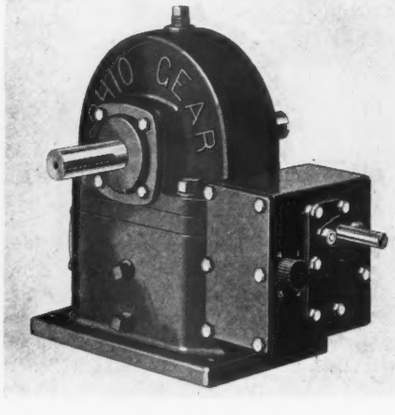
Company, Schenectady, N. Y. Insulating material covers the front end of the contacts. The spacing of the receptacles permits the number of different circuits to be brought to a panel within a given area on the switchboard to be increased. The design prevents any interchangeability of plugs.

■

## Ohio Speed Reducer with "Gear Shift"

A WORM-GEAR speed-reduction unit, combined with a selective dial which permits any of four speed changes to be used, has been placed on the market by The Ohio Gear Company, 133 East 179th St., Cleveland, Ohio.

Essentially, the unit consists of two parts; the worm and worm-wheel assembly which provide for the main reduction, and the speed-changer box which operates on much the same principle as an automobile transmission. The worm and worm wheel may be arranged for practically any reasonable ratio. The speed-changer gear ratios can also be varied within fairly wide ranges; although for most purposes it has been found that the two alternative sets of ratios which have been standardized are sufficient. The first set varies the speed in the proportions of 1 to 1 and 1½ to 1, 2 to 1 and 3 to 1, as compared with the worm wheel revolutions. The second alternative varies as 2 to 1, 1.87 to 1, 1.66 to 1, and 1.6 to 1. These ratios must be multiplied by the ratio of the worm-gear reducer to which the speed changing part is attached in order to give the ultimate reduction.

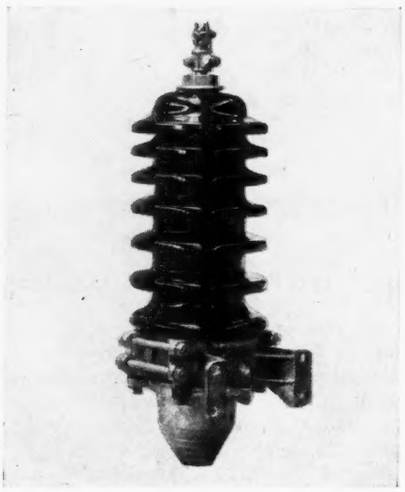



The worm is hardened and ground steel; the worm wheel is bronze and runs in an oil bath. Reducer shafts are mounted in ball bearings. Edges of the speed-changer gear teeth are rounded to facilitate easy engagement when operating the dial. As a further precaution against breakage, the mechanism is designed so that the gear-shift dial cannot be operated unless the unit is at rest. Sufficient clearance is allowed also so that no two sets of gear trains can be in mesh at the same time. Both the box and the worm assembly can be arranged for any operating position specified.

■

## Delta-Star Cable Terminators

OIL-FILLED terminators of 34.5-kv. capacity, for sealing the ends of lead-covered cables, have been announced by the Delta-Star Electric Company, 2400 Block, Fulton St., Chicago, Ill. Special attention has been



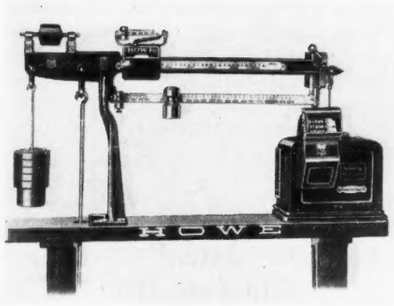
paid to the porcelain-bushing design to secure good thermal characteristics. Dry flashover 140 kv.; wet, 130 kilovolts.

■

## The Howe "Weightograph"

A SELF-CONTAINED unit, the "Weightograph," introduced by The Howe Scale Company, Rutland, Vt., is attachable to any beam scale or any scale convertible to beam operation. Without disturbing or replacing the scale, the unit is attached to the free end of the weightbeam in place of the beam stand.

Weight is reflected automatically, in illuminated figures, on a ground-glass reading screen. There is one moving element; an arm which is connected to the weightbeam supports a precision chart negative which passes between a



stationary light and a magnifying glass. The figures are then magnified and thrown on the reading screen.

Absence of parallax, or the distortion resulting from reading at an angle, is one of the features of this equipment mentioned by the manufacturer.

■

## Dunham Concealed Radiator

C. A. DUNHAM COMPANY, 450 East Ohio St., Chicago, Ill., announces the development of a concealed radiator so designed that it may be removed from the recess, if necessary, by disconnecting the steam pipes.

Seamless drawn copper tubes are used, connected to the headers by screwed ground joints. The connection is said to be permanently steam tight and eliminates gaskets and soldering, and makes each tube an independent, removable unit. The radiating fin is a continuous spiral metallically attached to the tube.

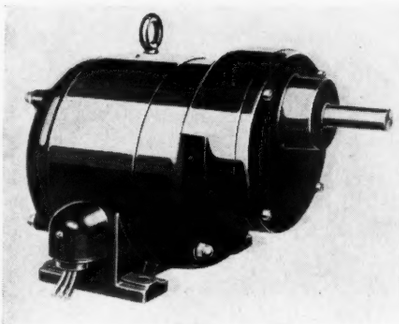
■

## Master "Geared-Head" Parallel-Shaft Motors

GEARED-HEAD motors of the parallel-shaft type in single-phase and d.c. units from 1/30 to 5 hp., and polyphase units in sizes from 1/30 to 20 hp., are now being made by the Master Electric Company, Dayton, Ohio. They are available in multiples of 0.25 for any ratio between a maximum reduction of 6 to 1 and a maximum acceleration of 2.5 to 1 of standard motor speed.

Anti-friction bearings are used throughout, with precision ball bearings on the motor shaft and roller bearings on the countershaft.

Gear housings can be arranged so that shafts project in any one of four different positions; at the top or bottom on the vertical center-line; or to the right or left on the horizonal center-line.

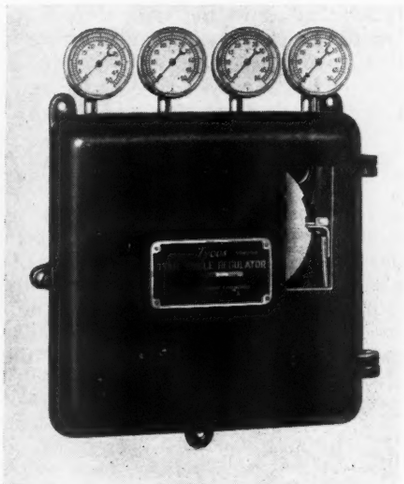


■

## Taylor Tyme-Cycle Regulator

TAYLOR Instrument Companies, Rochester, N. Y., announce the Tycos Tyme-Cycle Regulator, an instrument which consists of an electrically driven cam, which, as it revolves, progressively opens or closes small pilot valves. These valves in turn regulate the supply of compressed air to diaphragm valves, electro-pneumatic switches, or other pneumatically operated devices.

The cam is mounted on a cam shaft rotating in ball bearings. Steps are cut on the cam corresponding to the number of pilot air valves to be operated. Cam speed can be increased or decreased to meet process requirements by substituting new cams and gears.



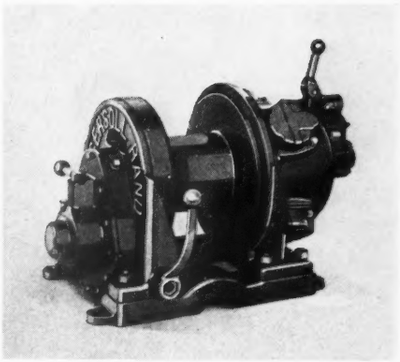
■

## Ingersoll-Rand "Utility" Air Hoist

MODEL HU has been added to the line of air hoists manufactured by the Ingersoll-Rand Company, 11 Broadway, New York, N. Y. This hoist has a rated capacity of 2,000 lb. at a rope speed of 120 f.p.m. Drum capacity is 550 ft. of ⅜-in. cable. The base is a heavy, cast-steel plate, provided with holes for bolting to flat surfaces and grooved to fit columns.

A reversible 4-cyl., radial piston-type air motor is used. Ample lubrication is provided for all working parts. Ball or roller bearings are used throughout. A clutch of the jaw type is provided for engaging or disengaging the motor. The brake is of the external contracting type.

Weight without cable is 490 lb., length 32 in., width 22 in., and height 23 inches.



■

## American Spiral-Welded Pipe

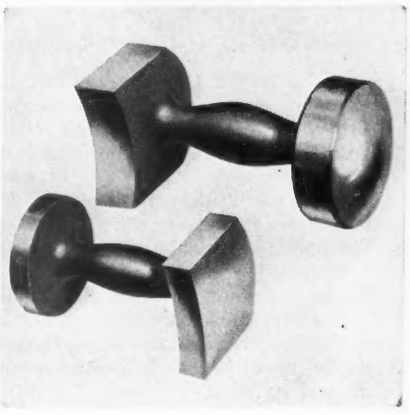
SPIRAL-WELDED pipe in lengths up to 40 ft. and from 6 to 24 in. in diameter is now being made by The American Rolling Mill Company, Middletown, Ohio. Wall thicknesses available range from 12 gage to ⅜ in. The pipe can be used with any of the standard couplings and is furnished with any type of coating desired—mill coat, asphalt inside and out, or galvanized.

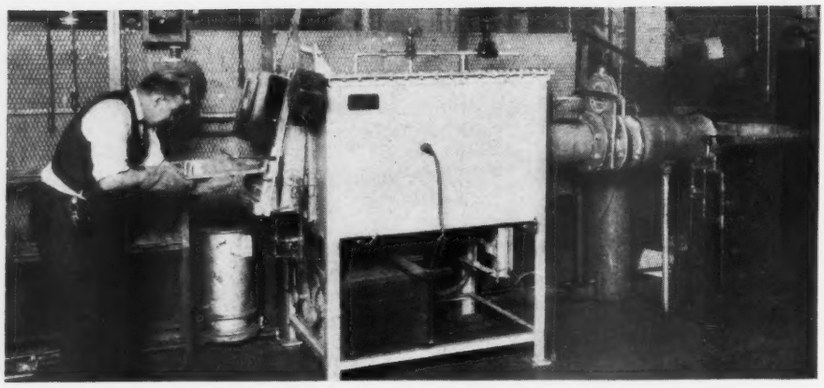
■

## Whitney Hand Dolly

HAND dollies in two sizes have been announced by the Whitney Metal Tool Company, 110 Forbes St., Rockford, Ill. These devices can be used in seven positions and are designed so that they will not roll when laid lengthwise on a bench or a table.

The large size, intended for shop use, weighs 7½ lb.; the smaller size weighs 3 lb. and may be carried in a tool box for outside work. The tools are drop forged and hardened and have machined surfaces.





## General Electric High-Temperature Furnace

AN electric furnace for temperatures up to 2,600 deg. F. has been added to the line of heat-treating equipment made by the General Electric Company, Schenectady, N. Y. This furnace is applicable for many processes, especially those that must be carried on in a reducing atmosphere such as copper brazing, the manufacture of Carboloy, or the brazing of Carboloy tips to steel.

Molybdenum wire heating elements operate in a hydrogen atmosphere which prevents both the molybdenum wire and the charge from becoming oxidized.

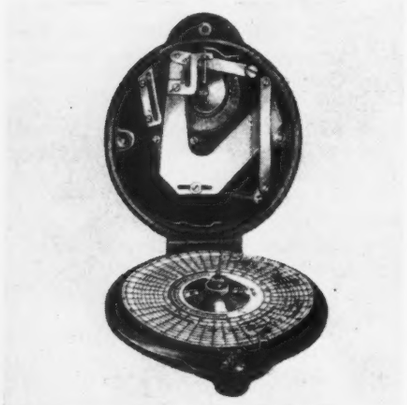
The door is manually operated. It slides on an inclined casting and, when closed, forms a seal against the escape of hydrogen and excludes air from the furnace.

There are two cooling chambers, one of which is equipped with a water jacket that allows the work to cool below the oxidizing temperature before it is removed.

■ ■

## Ohmer-Kienzle Seven-Day "Vibracorder"

EXACT clock time that any vehicle or any piece of machinery is in operation or is idle is recorded by the Ohmer-Kienzle seven-day "Vibracorder" introduced by the Ohmer Fare Register Company, Dayton, Ohio. A small disk



5 in. in diameter, taken from the instrument once a week, contains a permanent record of seven days' operation. The instrument is operated by vibrations or oscillations which are always present when a motor vehicle or any piece of machinery is running.

The operating mechanism is an eight-day, six-jewel clock with an easily read dial. In addition to moving the hands of the clock, the mechanism rotates a drum within the instrument bearing a specially prepared chart under the point of a steel stylus.

The chart is laid out with spaces for minutes, hours and days, and for both day and night operation. A wide line is plotted on the chart by the stylus as it moves over the chart, vibrating in unison with the machinery. In a similar manner a light line is drawn by the stylus when the machine is at rest.

■

## Detroit Seamless Lined Steel Tubes

A METHOD of lining steel tubing with metals or alloys has just been announced by the Detroit Seamless Steel Tubes Company, Detroit, Mich., which has secured exclusive patent rights to the process.

The inner lining metal and the outer shell are bonded by fusion. According to the manufacturer there is no evidence of separation and the union cannot be destroyed by manual means.

The company states that the greatest industrial possibility of the process will be realized in the production of steel-backed bearings. Tubes in lengths as great as 16 ft. can be fabricated, and from them bearings of any length can be cut by means of the screw machine or lathe.

Among the lining materials that have been used are bronze, copper, tin, and alloys. The lining is applied centrifugally under heat.

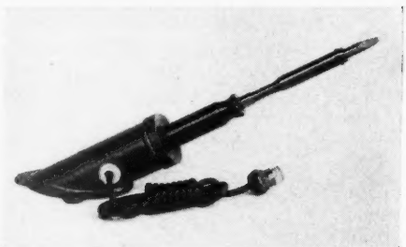
It is expected that tubes lined with non-corrosive metals will find use for conveying liquids whose chemical properties deteriorate steel; and as water pipes to displace tubes of copper or other material where strength is a desirable factor.

■

## Electric "Esico" Cordless Soldering Iron

A CORDLESS soldering iron, heated by inserting it in a socket base which is part of the outfit, has been announced by the Electric Soldering Iron Company, Inc., 135 West 17th St., New York, N. Y. Projecting from the handle of the iron is a ring terminal which is said to make contact in the base no matter how it is inserted.

The base is made at an angle so that the iron may be withdrawn and carried in a natural arc to the work.

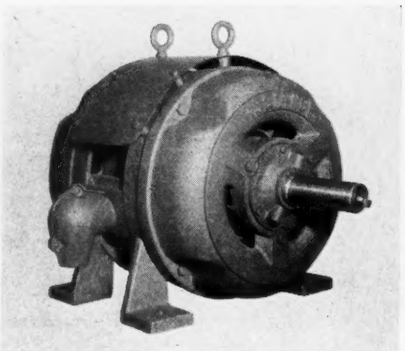


■

## Drip Covers for Reliance Motors

DRIP covers applicable to either the a.c. or d.c. motors that they manufacture have been announced by The Reliance Electric & Engineering Company, 1042 Ivanhoe Road, Cleveland, Ohio. The covers are used to protect the motors in bad locations from dropping water, acid or other injurious solutions.

Heavy-gage sheet steel is used and the covers are securely bolted to the motor frames in roof-like fashion so that an opening is provided between motor and cover to permit free circulation.

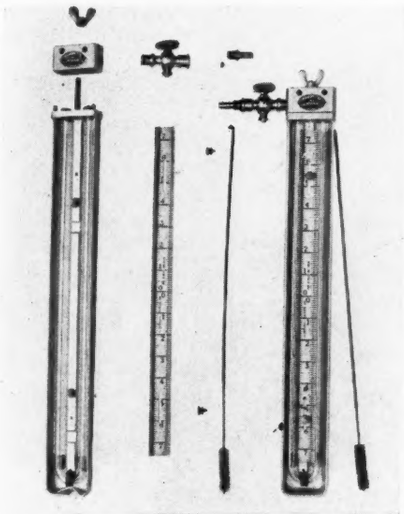


## Meriam Manometer

U-TUBE manometers for measuring the pressure or flow of liquids, steam or gas, and which may be removed from the line for cleaning without unscrewing the pipe connections, are now being made and marketed by the Meriam Company, 1955 West 112th St., Cleveland, Ohio.

These instruments consist of two separable parts—the head, which is permanently attached by the pipe connectors to the line; and the housing which carries the scale and tube, and which may be removed from the head by unscrewing a wing nut. The top of the housing carries a threaded column which passes completely through the head-casting and carries the wing nut.

The wing nut engages with a vertical stud in the housing, and serves to hold



the two parts of the instrument in place. Rubber gaskets which keep the ends of the U-tubes pressure-tight fit into tapered holes in the head communicating with the pipe-line. Spring clips at the back of the housing hold a cleaning brush suitable for the size of U-tube used.

■

## Neon Units for Industrial Illumination

PRACTICAL application of rare gas tubes, commonly known as neon tubes, to operate on standard 110-220-volt current, is announced by Claude Neon Lights, Inc., 41 East 42nd St., New York, N. Y. Light from these tubes is said to have a non-glaring, unusually soft quality due principally to better distribution which eliminates hard shadows and high reflections.

The light is of equal intensity throughout the entire length of the tube, and is distributed without the aid of diffusing glass. These tubes also eliminate centers of high intensity which

necessitate constant readjustment of the pupils of the eye, and consequent irritation.

Colors are derived directly from the source of the light—electrified rare gases. A light which approximates daylight quality, to show objects at their real color values, is obtainable in all unit sizes.

■

## Holophane "Realite"

TOTALLY indirect, dust-resisting lighting units that direct the light outward and upward at wide angles on to the ceiling have been introduced by the Holophane Company, Inc., 342 Madison Ave., New York, N. Y. All visible parts are made of dull-finished aluminum.

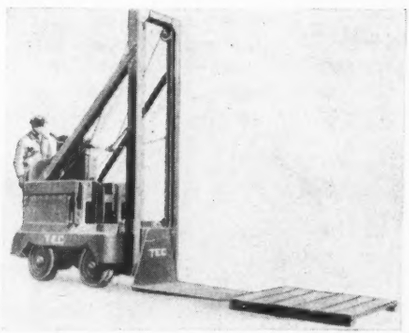
The fixture is supplied with an extension hickey, drop canopy, swivel joint and stem suspension with wire included but not attached to terminals. The unit is lamped from the bottom by unscrewing the knob, dropping off the lower step of the mask and releasing the aluminum cup by rotating it until the keyhole slots disengage. The controlled light distribution is produced by a two-piece prismatic refractor, smooth on the outside, held against gaskets between a cast bottom flange and an upper socket cover, and concealed by the aluminum mask and baffle. The lamp is entirely inclosed in the combined glass refractor

and aluminum-cup reflector, preventing direct contact with dirt. Cleaning is accomplished by wiping off the smooth outside of the glass refractor and the smooth inside of the aluminum mask.

■

## Terminal Electric Elevating Truck

A FOUR-WHEEL drive, skid-handling truck has been added to the line of materials-handling equipment manufactured by the Terminal Engineering Company, 17 Battery Place, New York, N. Y. The machine is small enough to work in box cars and carries its 3,000-lb. load in an overhung position.



It has a four-wheel, four-motor drive, and travels at 10 m.p.h. empty and from 7 to 9 m.p.h. loaded. Elevating speed varies from 25 to 40 ft. per min. with the standard motor, but reaches a maximum of 60 ft. per min. if a special high-speed hoist motor is used.

The truck is operated from a storage battery in a steel compartment placed over the wheels at the driver's end, to act as a counter-balance.

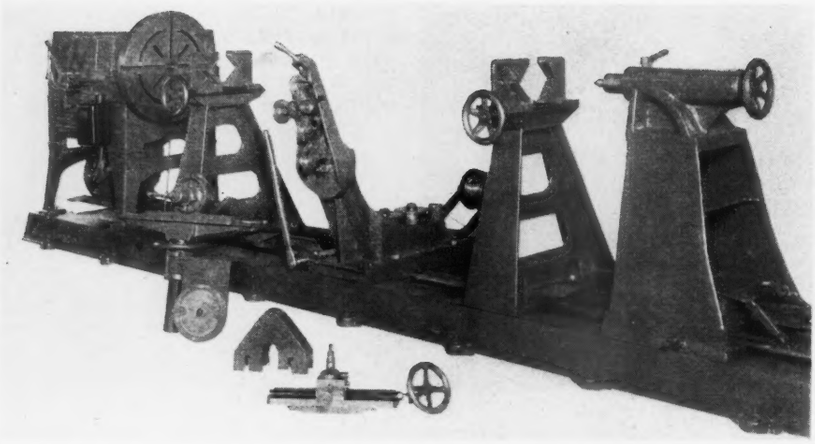
Safety devices used include: an automatic stop on the up-stroke of the table; two independent sets of brakes; mechanical on two wheels and electrical on four wheels; controls located within the outer edges of the truck at all times.

■

## Mutual Universal Winding and Banding Machine

WINDING and banding machines designed especially for heavy-duty service in repair shops and plant maintenance departments have been announced by the Mutual Foundry & Machine Company, Atlanta, Ga. The machine bed is 16 ft. long with a maximum distance between centers of 10 ft. It will swing armatures up to 48 in. in diameter over the carriage.

The driving equipment consists of an eight-speed geared unit, driven by a 3-hp. motor through silent chain direct to a flywheel equipped with a disk



clutch. All gears are of steel. Intermediate bearings are bronze bushed and the main spindle is equipped with roller bearings. Alemite lubrication is provided for all bearings. An external-type automotive brake is incorporated in the construction. Adjustment is provided so that no slack wire will occur during winding operations. A four-dial counter is standard equipment. One foot pedal is located at the head end permanently, and two are provided to slide along the shaft.

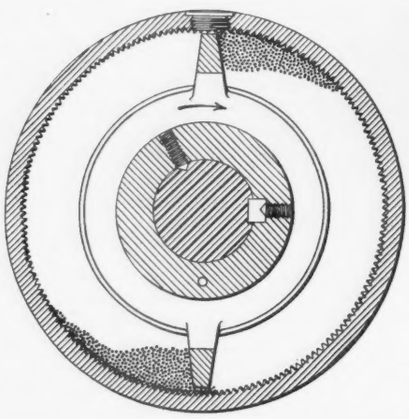
The carriage is designed to support banding attachments and undercutting and turning units.

■ ■

## Hill-Pulvis Centrifugal Clutch

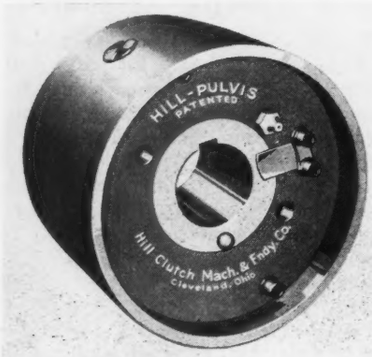
SURE, gradual power transmission by centrifugally increasing density of graphite-treated chilled shot against a driving and a driven element is the principle employed in the Hill-Pulvis clutch announced by the Hill Clutch Machine & Foundry Company, Cleveland, Ohio. This clutch can be applied to individual drives, either as a motor pulley, V-belt sheave, gear or sprocket, or as a coupling on direct-connected drives.

The winged rotor is the driving element and the serrated shell is the driven element. Wings are provided with orifices to distribute the chilled shot evenly, thus effecting dynamic balance during its operation. When the line switch is closed, the driving motor comes immediately up to speed. The winged wheel turns at the same speed and rotates the charge of chilled shot. The rotating rotor wings set up centrifugal action, forcing chilled shot out against the serrated inner surface of the shell. The



chilled shot mass packs tightly and assumes a definite position in front of each wing. Power is transmitted in gradually increasing amounts until the maximum is reached without loss to the driven element. Every clutch is equipped with a "tell-tale" device that indicates duration of starting time and shows overloading.

Both starting characteristics and driving power can be changed in the same clutch by changing the quantity of chilled shot.

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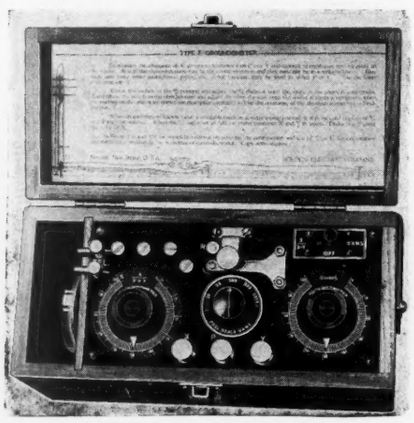
## Acme Vertical Steel Door

THE Acme Partition Company, 3535 Peralta St., Oakland, Calif., has introduced a vertical steel door. Resting on a central bearing, supporting a rotating disk, the slats are of 16-gage steel and are constructed to withstand wind pressure. The door, which may be made as large as 200 ft. wide and 30 ft. high, operates in two units, by hand or motor. It is carried on an overhead steel track and supported by ball bearing sheaves. The curtain is attached to a central shaft, and requires a groove only ⅜ in. wide. Provision has been made to insure operation during the winter. The door is designed for hangar, factory and other industrial uses.

■

## Borden Type E Groundometer

THIS device is the latest addition to the line of ground testing equipment made by the Borden Electric Company, 480 Broad St., Newark, N. J. The face plate is of Bakelite and the



scale plates are made of nickel-steel. Binding posts are of nickled brass and are designed for use with either plug, flat-clip or spring-clip terminals.

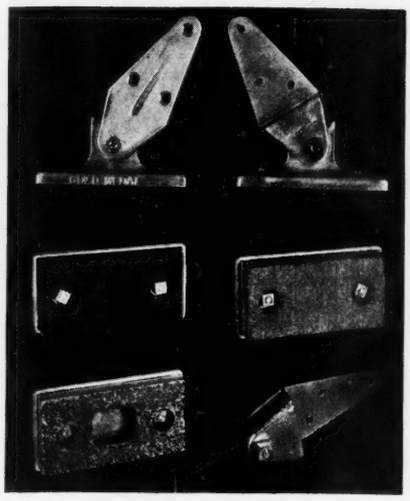
Each telephone receiver is subjected to a breakdown test of 1,000 volts between the winding and the case; the hard rubber cap is protected from mechanical injury by a metal retaining ring. Case and ring are nickel plated.

Overall size of the meter is 9⅜ x 4¼ x 6½ in. It is inclosed in an oak case with a leather handle. The battery is a single dry cell and, it is claimed, requires renewal not oftener than once a year.

■

## Patent Scaffolding Safety Ladder Feet

SAFETY ladder feet of Bohnalite, with interchangeable shoes to suit varying surfaces, have been introduced by The Patent Scaffolding Company, 1550 Dayton St., Chicago, Ill. All weight bears on the frame rather than on the bolts or screws with which the frame is attached to the ladder. Side rails are thus guarded against splitting.



All swivel action is between the lower frame and shoe.

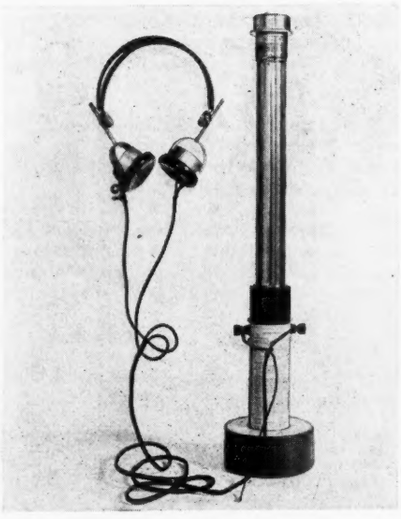
One pair of frames will serve for four different shoe types. Variations of floor surfaces are provided for by three styles of grips—one cork faced, another carborundum, and the third a rubber suction grip. For soft footing such as loose earth, crushed stone, and so forth, the fourth accessory is a pair of steel points.

■

## National "Nepcoduct Divinator"

DUCTS and outlets hidden under floor coverings or imbedded in concrete may be located by means of a device called the "Nepcoduct Divinator" now being made and marketed by the National Electric Products Corporation, Pittsburgh, Pa. Metal ducts are found by carrying the instrument along the floor until a definite tone is heard in the earphones.

Outlets may be found by moving the instrument along the duct until a louder sound is heard in the earphones.



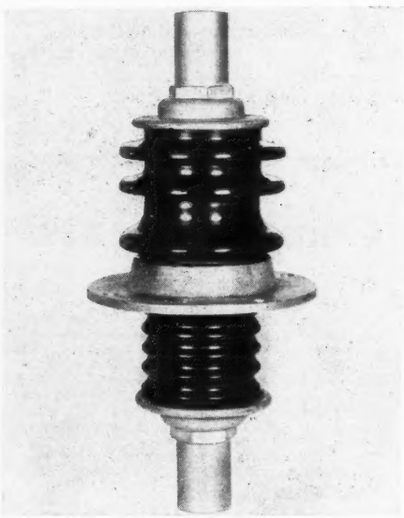
## American Manganese Steel Welding Rod

A DEPOSIT, said to be equal in toughness and wear resistance to manganese steel, is obtained by the use of Amsco manganese steel welding rod, now being made and marketed by the American Manganese Steel Company, Chicago Heights, Ill. The rod is stocked in A.S.&W. gage No. 5 in 36-in. lengths.

■

## Delta-Star High-Capacity Roof Bushings

A LINE of high-current-capacity, porcelain-bushing roof entrances has been announced by The Delta-Star Electric Company, 2400 Block, Fulton St., Chicago, Ill. The bushing is compound filled at the factory, and is said to be free from corona inside the porcelain even when flashover potentials are applied.

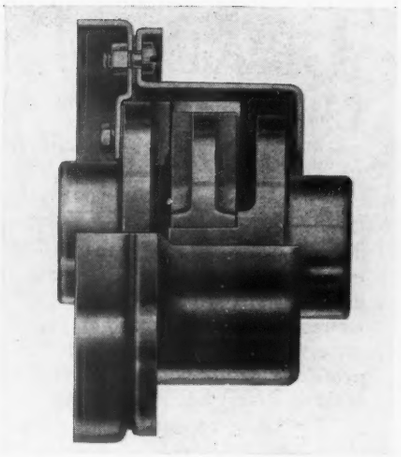


It is of wet process porcelain with graded petticoats. Above the roof, the dry flashover is 80 kv., wet 55 kv. The portion below the roof has a dry flashover of 55 kv. Terminals on either end are machined to standard pipe sizes making possible the use of standard I.P.S. connection fittings.

■

## Smith & Serrell Cross-Type Coupling

TWO forged-steel flanges with prongs, a light-weight center cross, and a pressed-steel inclosing case comprise the flexible coupling announced by Smith & Serrell, Globe Indemnity Building, Newark, N. J. The inclosing case is a lubricant reservoir and also a "limit stop," preventing the free hub from operating too far out of line.



The two flanges of the inclosing grease case can be separated for refilling or for checking shaft alignment.

■

## Adalet Vapor-Proof Conduit Fittings

VAPOR-PROOF conduit wiring fittings which, it is stated, combine complete protection with ready facility for making changes and additions have been announced by the Adalet Manufacturing Company, 4610 St. Clair Ave., Cleveland, Ohio.

Fittings consist of a one-piece casting with provision for attaching a guard or reflector holder and are sealed oil and gas proof by means of a glycerine-impregnated gasket resting on a machined surface.

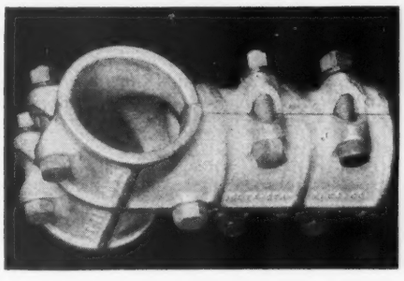
All units are provided with outlets. The guard is of the bayonet-joint type, with two locking screws.

■

## Delta-Star Copper Fittings

THE Delta-Star Electric Company, 2400 Block, Fulton St., Chicago, Ill., announce a cast-to-size line of connectors for outdoor substation, copper-tube buses. Clamping bolts in connection with the joint contact surfaces give a heavy gripping action insuring good contact.

Connectors are cast in two halves and are fully interchangeable. They are made for all sizes of copper tubing.



# TRADE LITERATURE

## *You Should Know About*

**Copies of literature which is described on this page can be obtained by writing to the manufacturer whose name and address are mentioned. It is always advisable to state the name and number of bulletin or catalog described, as given in these columns.**

* * *

*(63)* FIBER — Booklet, "Diamond Vulcanized Fibre," 40 pages, method of manufacture, stock sizes and grades, and some suggested uses. — Continental-Diamond Fibre Company, Newark, Del.

*(64)* WIRING—Wall chart illustrating stock of 333 items, metal molding and devices used for surface wiring.—National Electric Products Corporation, Pittsburgh, Pa.

*(65)* SCALES—Bulletin, 12 pages, the Howe "Weightograph." Constructtion, details, and illustrations of this device in use.—The Howe Scale Company, Rutland, Vt.

*(66)* LAMPS—Bulletin 1280-P, 8 pages, "Pointolite" lamps for laboratory and instrument use.—James G. Biddle Company, 1211 Arch St., Philadelphia, Pa.

*(67)* WASHFOUNTAINS—Catalog, "Fixtures for Group Washing," washfountains, 5-In-A-Group showers, drinking fountains, and foot-fountains.—Bradley Washfountain Company, 2203 Michigan St., Milwaukee, Wis.

*(68)* SWITCHES—Leaflet L-20502-A, Type M test switch, construction and design features, and wiring diagrams.—Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

*(69)* MATERIALS HANDLING—Folder, illustrations of lift trucks of all sizes, types and capacities.—Crescent Truck Company, Lebanon, Pa.

*(70)* PUMPS—Bulletin D-423-S4, 4 pages, vertical triplex, single-acting power pumps.—Worthington Pump & Machinery Corporation, Harrison, N. J.

*(71)* FREQUENCY METERS—Bulletin 1270, 12 pages, "Frahm" vibrating-reed frequency meters, portable, and switchboard types.—James G. Biddle Company, 1211 Arch St., Philadelphia, Pa.

*(72)* WIRE ROPE—Folder, "Hazard Korodless" chrome nickel alloy wire rope. —Hazard Wire Rope Company, Wilkes-Barre, Pa.

*(73)* COMPRESSOR CONTROL — Bulletin 102, 4 pages, dual compressor control designed to meet varying demands for compressed air.—Pennsylvania Pump & Compressor Company, Easton, Pa.

*(74)* ROCK DRILLS—Bulletin W-1200-B1, 4 pages, Worthington-Gilman rock drills and drill steel shop equipment.—Worthington Pump & Machinery Corporation, Harrison, N. J.

*(75)* AIR EJECTORS — Folder D.M.F. 5299, steam-jet air ejectors for use in industries employing vacuum processes.—Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

*(76)* MOTORS — Folder GEA-1341, totally inclosed, fan-cooled induction motors for Class I, Group D hazardous locations. —General Electric Company, Schenectady, N. Y.

*(77)* INSTRUMENTS — Bulletin 1275, 16 pages, "Jagabi" speed-measuring instruments.—James G. Biddle Company, 1211 Arch St., Philadelphia, Pa.

## Coming Events

**Second National Industrial Congress Featuring Management, Maintenance and Materials Handling**—Public Auditorium, Cleveland, Ohio, April 13 to 18, 1931, inc. In conjunction, Second National Industrial Equipment Exposition. Concerning technical sessions address P. T. Wetter, American Society of Mechanical Engineers, 29 West 39th St., New York City. Exposition under management Midwestern Engineering Exposition, 308 West Washington St., Chicago, Ill.

**American Welding Society** — Annual meeting, New York City, Apr. 22-24. Secretary, M. M. Kelly, 33 West 39th St., New York, N. Y.

**National Fire Protection Association** —35th annual meeting, Toronto, Can. May 11 to 14, 1931. Association headquarters, 60 Batterymarch St., Boston, Mass.

**National Electric Light Association**—54th convention and exhibition, Municipal Auditorium, Atlantic City, N. J., June 8 to 12, 1031. Secretary, A. Jackson Marshall, 420 Lexington Ave., New York, N. Y.

**Association of Iron and Steel Electrical Engineers**—Iron and Steel Exposition, Cleveland Public Auditorium Annex, Cleveland, Ohio, June 14-15, 1931. Managing Director, John F. Kelly, Empire Bldg., Pittsburgh, Pa.

**American Society for Testing Materials**—Annual meeting, Stevens Hotel, Chicago, Ill., June 22-26. Secretary, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

**American Institute of Electrical Engineers** — Annual summer convention, Asheville, N. C., June 22-26. Secretary, F. L. Hutchinson, 33 West 39th St., New York, N. Y.

*(78)* PANELBOARDS — Circular 87, 12 pages, "Safe-Converti-Fuse" unit panelboards.—The Trumbull Electric Manufacturing Company, Plainville, Conn.

*(79)* FIRST AID — Catalog FA-2, 36 pages, safety appliances and first aid materials.—Mine Safety Appliances Company, Braddock, Thomas and Meade Streets, Pittsburgh, Pa.

*(80)* PRESSURE REGULATION EQUIPMENT —Catalog, 60 pages, pressure regulation equipment for gas, steam, liquids and vapors.—Natural Gas Equipment Company, Inc., Los Angeles, Calif.

*(81)* LIGHTING—Circular 20-201, Century-Roth emergency lighting system.—Roth Brothers & Company, Division of Century Electric Company, 1400 West Adams St., Chicago, Ill.

*(82)* CHART—A.S.H.V.E. chart for determining the friction of air in pipes.—Bayley Blower Company, 1938 South Fourth St., Milwaukee, Wis.

*(83)* PIPE BENDING — Bulletin 50, 16 pages, "The Practice and Theory of Bending Wrought Iron Pipe."—A. M. Byers Company, Clark Building, Pittsburgh, Pa.

*(84)* ELECTRICAL INSTRUMENTS—Bulletin 1280-S, 1000-volt "Super-Meg" insulation tester.—James G. Biddle Company, 1211 Arch St., Philadelphia, Pa.

*(85)* ALUMINUM ALLOYS — Booklet AD33, 90 pages, "Alcoa Aluminum for Truck Bodies."—Aluminum Company of America, Pittsburgh, Pa.

*(86)* LIGHTING EQUIPMENT—"Commercial and Industrial Catalog No. 4."—The Quadrangle Manufacturing Company, 32 South Peoria St., Chicago, Ill.

*(87)* MOTORS—Bulletin 169, 8 pages, mechanical and electrical characteristics of slip-ring motors.—Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis, Mo.

*(88)* TRANSFORMERS—Circular 1886, 12 pages, descriptions of application, operation, and construction of dry-type transformers and auto-transformers. — Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

*(89)* ARC WELDING—Section 3304, arc welding equipment and accessories.—The Lincoln Electric Company, Cleveland, Ohio.

*(90)* LUBRICATION—Bulletin No. 7, 36 pages, gravity-type oil filters.—Wm. Nugent & Company, Inc., 410 North Hermitage Ave., Chicago, Ill.

*(91)* POWER TRANSMISSION — Catalog 135, 32 pages, small, heavy-duty, worm-gear speed-reducers.—D. O. James Manufacturing Company, 1120 West Monroe St., Chicago, Ill.

*(92)* FIBER—Catalog, 40 pages, Diamond Vulcanized fiber.—Continental-Diamond Fibre Company, Newark, Del.

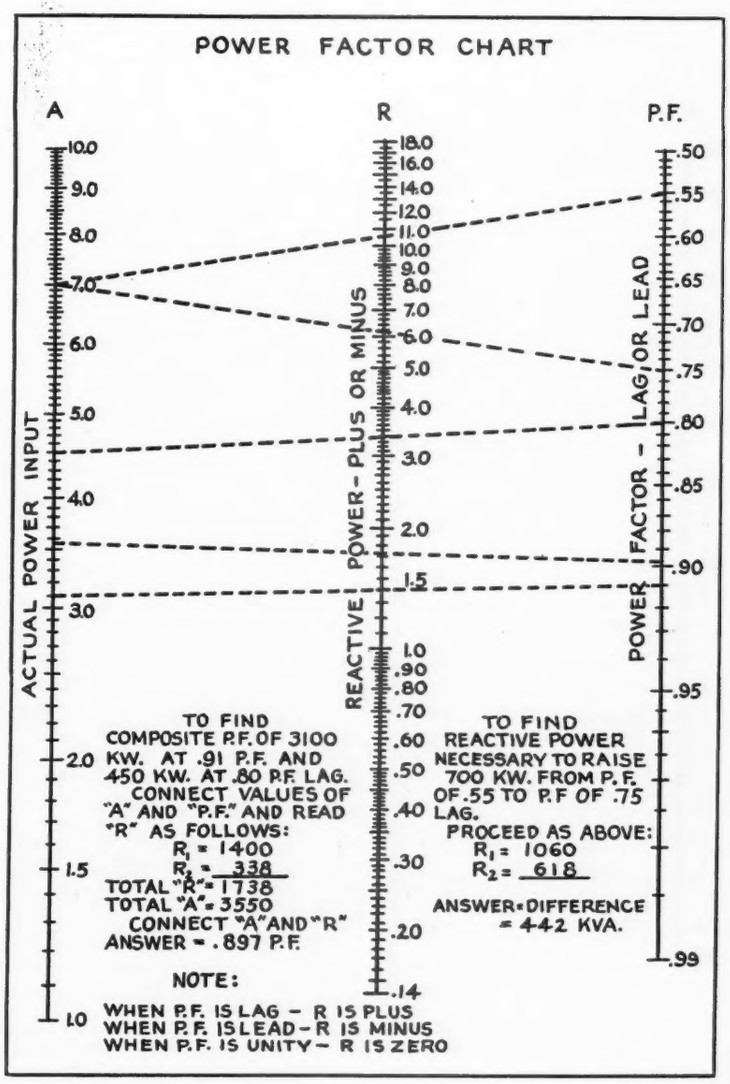
*(93)* LUBRICATION—Booklet, 24 pages, "Colloidal Graphite." — Acheson Oildag Company, 654 Madison Ave., New York, N. Y.

# INDUSTRIAL ENGINEERING'S DATA SHEETS

## Power Factor Calculation

THE accompanying chart was developed to simplify the solution of ordinary power-factor problems encountered in the average plant. Its use obviates the necessity for drawing intricate vector diagrams and reduces the number of calculations employed.

For leading power factor subtract the *R* values instead of adding them as in the cases illustrated. The chart may also be used to determine the resultant power factor of a circuit when a load is subtracted from an existing load.


POWER FACTOR CHART
A
R
P.F.
ACTUAL POWER INPUT
REACTIVE POWER - PLUS OR MINUS
POWER FACTOR - LAG, OR LEAD
TO FIND COMPOSITE P.F. OF 3100 KW. AT .91 P.F. AND 450 KW. AT .80 P.F. LAG. CONNECT VALUES OF "A" AND "P.F." AND READ "R" AS FOLLOWS:
R1 = 1400
R2 = 338
TOTAL "R" = 1738
TOTAL "A" = 3550
CONNECT "A" AND "R"
ANSWER = .897 P.F.
TO FIND REACTIVE POWER NECESSARY TO RAISE 700 KW. FROM P.F. OF .55 TO P.F OF .75 LAG.
PROCEED AS ABOVE:
R1 = 1060
R2 = 618
ANSWER = DIFFERENCE = 442 KVA.
NOTE:
WHEN P.F. IS LAG - R IS PLUS
WHEN P.F. IS LEAD - R IS MINUS
WHEN P.F. IS UNITY - R IS ZERO

*Submitted by A. Puishes, Mechanical Department*
*Procter and Gamble Manufacturing Company, Port Ivory, S. I., N. Y.*

# INDUSTRIAL ENGINEERING'S DATA SHEETS

## CRANE INSPECTION REPORT

Crane No. ..... Type ..... Hoist Serial .....

Inspected by ..... Date .....

KEY WORDS—OK, G = Good; F = Fair; W = Worn; A = Need Attention; C = Need Cleaning; T = Too Tight

### RUNWAY and CONDUCTORS

Track Alinement ..... Spread ..... Fastenings .....

Line Conductors ..... Conductor Supports .....

### TRUCKS and MAIN COLLECTORS

Truck Wheels, Flat Spots? ..... Flanges ..... End Play .....

Axle Bearings ..... Lubrication .....

Truck Drive Bearings ..... Lubrication ..... Gears .....

Gear Screws ..... Pinion ..... Key ..... Collectors .....

### GIRDERS and DRIVE

Drive Shaft ..... Couplings ..... Bearings ..... Lubrication .....

Foot Brake Shaft ..... Couplings ..... Bearings ..... Lubrication .....

Bridge Brake Case ..... Adjustment ..... Lubrication .....

Walkway ..... Railing ..... Ladder .....

Bridge Motor Support ..... Shaft Extension ..... Couplings .....

Bridge Drive Gear Case ..... Gears ..... Lubrication .....

### MOTORS

| Location | Armature or Rotor | Commutator or Slip Rings | Brushes | Brush Holders | Bearings | Lubrication |
|---|---|---|---|---|---|---|
| Bridge | | | | | | |
| Hoist | | | | | | |
| Aux. Hoist | | | | | | |
| Trolley | | | | | | |

Trolley Wheels ..... Trolley Wheel Bearings ..... Lubrication .....

Trolley Gear Case ..... Case Support ..... Gears ..... Lubrication .....

Hoist Gear Case ..... Main Gear Train ..... Comp. Train ..... Lubrication .....

Mech. Brake ..... Drift * ..... Elec. Brake ..... Adjustment ..... Lubrication .....

Drum ..... Cable ..... Cable Pin ..... Limit Switch .....

Limit Switch Adjustment ..... Hook ..... Sheaves ..... Lubrication .....

Trolley Conductors ..... Trolley Collectors ..... Cage Roof .....

Door ..... Windows ..... Foot Brake Treadle ..... Cont. Levers .....

### CONTROLLERS

| | Brushes | Brush Holders | Contacts | Wiring | Springs | Resistance | Screws Tight |
|---|---|---|---|---|---|---|---|
| Bridge | | | | | | | |
| Hoist | | | | | | | |
| Aux. Hoist | | | | | | | |
| Trolley | | | | | | | |

* The load should come to rest, from full speed lowering, almost instantly when the controller is centered.

*Courtesy Shepard Niles Crane & Hoist Corporation*

# A PLATFORM FOR AMERICAN BUSINESS

*A Statement of Underlying Principles with some Practical Suggestions to Guide in Planning Future Progress*

PRESENTED BY McGRAW-HILL PUBLISHING COMPANY, INC.

THE BUSINESS DEPRESSION of 1930 was no mere passing episode. The appalling loss and suffering entailed have struck home the more forcibly because they followed a period of unparalleled prosperity in a country that still possesses vast wealth and abundant resources. As a result of its duration and severity, the depression has shocked business, governmental and social agencies into commendable activity for the relief of human suffering and distress.

But, what is more significant for the future, it has also aroused an insistent demand for a searching analysis of the weak spots of the business and economic systems under which such a calamity was possible. It is an encouraging sign that men are beginning to question whether these recurring periods of boom and depression are not preventable; whether it is possible under better management to insure greater security to all classes of people who are willing to work; whether their faith in American achievement and standards of living can be preserved.

Evidence is multiplying that these questions can be answered in the affirmative; that this challenge to the American business and economic systems can be met in such a manner as to justify our confidence in them. Instead of regarding business depression as a storm to be weathered or a condition that must be endured and allowed to "work itself out," thinking men are beginning to look upon it as an economic plague that can be averted and wiped out by preventive measures. Sentiment is stirring in favor of doing something about it, heeding the warning of our latest experience and preparing actively to meet the issue it raises.

It is the responsibility of the business press to crystallize constructive policies and to encourage progressive leadership. Therefore, the McGraw-Hill Publishing Company desires to do its part in helping to clarify the situation and to stimulate thought and action. It believes in the philosophy of individual enterprise and cooperative effort on which American achievement has been based. And it has confidence in the ability of American management to recognize and adopt sound economic principles as a basis for constructive business policies. But it is equally certain that only by conscientious effort on the part of each business unit, large or small, can American business as a whole return to normal and pursue a steady course.

PLANNING IS ESSENTIAL for uninterrupted progress. To assist in such a program the McGraw-Hill Publishing Company offers through its publications the following principles and practical suggestions as a guide in formulating individual plans. They are not presented as a ready-made formula for success, but as a foundation on which business can be built with some protection from the shocks and dislocations that have plagued it.

money may be placed in capital expenditures—modernization, research for development, new patents, etc.

account just as they do the cost of a patent or a new building.)

**B.** Each business enterprise has a responsibility to aid in the development of regional and national resources.

**Development of National Resources**

(1) Encourage and cooperate in the coordination and promotion of the economic area in which you are located through constructive programs for the improvement of agricultural, commercial, industrial and community development. (*Example*—New England Council.)

(2) Assist in the work of national associations devoted to the improvement of business ethics, the promotion of higher standards in the commercial, industrial, financial and political administration of the country, and the simplification of the laws governing business. (*Example*—Chamber of Commerce of the United States.)

## IV—Maintenance of World Business

Probably the greatest potential market for present and future American products lies in that foreign field represented by the present difference between the living standards of the American public and those of a billion and a half people in many other countries. Any slight increase in the living standards of these vast populations will bring immediate benefits to American manufacturers, as the largest producers of those commodities contributing to labor saving and luxury.

**A.** Support cooperative studies and formulation of world policies among business interests through international business organizations on such subjects as —

**International Business Cooperation**

(1) World tariffs.
(2) Trade discriminations.
(3) International movement of capital.
(4) War debts and reparations.

**B.** Promote uniformity in foreign trade practice by encouraging coordination among organized industries.

account just as they do the cost of a patent of a new building.)

money may be placed in capital expenditures—modernization, research for development, new patents, etc.

**Sales Control**

**C.** Carry this long term planning into sales control, involving distribution methods, sales forecasting and pricing.

(1) Revise present methods of distribution and service to conform to the best interests of the customer. (*Example*—establishment of retail stores by mail order houses.)

(2) Prepare sales forecasts by products and by markets with regard to competition. (Leading institutions have found that modern sales forecasting can be correct within 2 to 3% for a year ahead and within 5 to 15% for three years ahead.)

(3) Know costs and stop selling at a loss. Maintain firm minimum prices based on production costs. (Business history shows a high degree of prosperity among those companies, large or small, which have had the courage to stand on a minimum price that insured a profit.)

(4) Plan sales organization, sales program and advertising on at least a three-year basis.

**Production Modernization**

**D.** Plan for uniform production as far ahead as possible on the basis of sales requirements already determined.

(1) Modernize and replace every existing production facility, including plants, factory and office equipment and methods where it is possible to effect cost reduction and greater production flexibility. (Stores, banks, and offices have a production problem no less than factories.)

(2) Do not expand production facilities in the mere hope for lower costs through larger production, but only where the long term forecast shows the necessity for additional facilities.

(3) Base purchase of materials, supplies and equipment upon the marketing and production program for the three-year period and make purchases as far ahead as practicable.

**Financial Policies**

**E.** Stabilize financing. Working capital requirements for labor and material, and business capital requirements for development and expansion, can be determined with reasonable accuracy for a period ahead by long term planning.

(1) Do not depend permanently upon bank credit for purposes other than short-term loans for current working capital. (In the interim partial payment financing of equipment, etc., is widely accepted as sound business practice.)

(2) Raise needed fixed capital requirements by bond or stock issues whenever reasonably advantageous.

(3) Invest surplus in short-term commercial paper or good bonds rather than employing it in call money or for purely speculative purposes.

Many of America's soundest corporations have adopted these financial policies.

# GENERAL OBJECTIVES

*The following general objectives are fundamental in planning sound business developments:*

## 1. Maintenance of Established Standards of Living

The belief that there is danger of a general overproduction of wealth, that technical development necessarily involves unemployment, or that standards of living cannot be indefinitely increased is an economic fallacy. American business should not yield to it in any of the policies it pursues. Rather it must protect and preserve our economic standards and social traditions by maintaining high purchasing power and regularity of employment and dividend disbursements, based on more stabilized methods of management and financing made possible by long-term planning.

**RECOMMENDATION: Conserve and add to the gains achieved in the past ten years through technical advance, improved forms of industrial organization and methods of management, and new devices for financing industrial and market expansion. Increase efficiency in the economic production and distribution of goods and services so as to facilitate their widest possible consumption and thereby raise the standard of living of the American people.**

## 2. Stabilization of Future Business Growth

So long as there are wide fluctuations in business and in price levels, the gains to some groups are cancelled by losses to others and there is no net gain to the country as a whole. The interests of the speculative and creditor groups should be subordinated to the interests of those concerned with the production and distribution of goods and services. The latter should have a larger measure of leadership in business policy to insure sound and lasting prosperity.

This leadership can be exercised only by a more deliberate process of long term planning and organization for the direction and development of business operations. Such effort involves market analysis, sales control, product development, modernization of factory and office methods, foresight in purchasing, long-term financing of fixed capital requirements and a stimulated program of capital investment in 1931 for the restoration of business volume. All this must be supported by broader policies of coordination within the industry or trade, cooperation with labor and participation in the organized development of regional and national resources.

**RECOMMENDATION: Direct individual and organized effort to check excessive and unbalanced industrial and financial expansion, and prevent wide changes in price levels. This will remove the incentive to speculative gain, avoid conflict of creditor and debtor groups, and promote confidence in long-term investment and borrowing. It will also encourage productive and commercial enterprise, maintain a steady increase in consumer purchasing power and stabilize business progress.**

## 3. Promotion of International Business Cooperation

The world is economically interdependent. Though the United States is the dominant factor in world prosperity, she cannot maintain or increase her own prosperity indefinitely without sharing it with the world, nor can her business system survive unless, by sharing its benefits, the other nations of the world can preserve their faith in it. This calls for a more active policy of international cooperation on the part of American business to assist in the gradual reduction or removal of unnecessary trade barriers that interfere with the natural exchange of goods and services between peoples, the development of a more stabilized international mechanism for the movement of capital and control of credit, and the revision of war debts and reparations.

**RECOMMENDATION: Support individual or organized effort to promote cooperation among business and financial interests of the United States and other countries, in order to facilitate the normal international movement of goods, services and capital, and thereby enhance economic stability at home and elevate standards of living abroad.**

## 4. Encouragement of Private Initiative and Responsibility vs. Extension of Governmental Activity

American business should encourage self-government. It has already shifted enough of its responsibility and thereby yielded enough of its initiative to government and must stand its ground against further extension of governmental action in matters in which it can assume responsibility itself.

The essential function of government is to keep clear the field of economic activity for private business initiative and to assure a basis of fair and equal competition in domestic and foreign trade. It should refrain from competing with any kind of business itself. It should facilitate and encourage the development of necessary controls upon business through organized self government. It should safeguard the economic stability of the country by maintaining stability in its own fiscal and international policies. It should reduce to the minimum the number of laws affecting business.

**RECOMMENDATION: Oppose governmental regulation, control or expenditure which tends to limit or weaken private individual initiative or cooperative effort, or to diminish the responsibility of the individual business concern or organized industry, for the accomplishment of the objectives stated above.**

# RESPONSIBILITY FOR ACTION

This course of action for (1) the maintenance and elevation of American standards of living, (2) the stable development of American business, (3) the promotion of international cooperation and (4) the restriction of governmental encroachment upon private initiative and cooperative effort cannot be carried out without the earnest participation of individuals and organized groups representing all types of business and industrial activity.

*Upon the following major groups the main burden of responsibility rests:*

**A. Industrial and Business Management:** A few thousand business concerns in this country employ the bulk of the wage-earners, originate most of the consumer income, and produce the chief part of the goods and services that determine the standard of living. Upon the management of these concerns therefore rests the main responsibility for action that will:

(1) Formulate long-term plans for research, production, distribution, purchasing and financing.

(2) Support cooperative effort through industrial, trade and commercial organizations.

(3) Maintain wage scales that permit a high standard of living and purchasing power.

(4) Maintain and equalize employment by adjustment of working hours.

(5) Establish a reserve to protect the security of employment in times of reduced production.

(6) Establish and maintain stable prices.

(7) Maintain reasonable, stable dividends, conserving surplus accumulated in periods of prosperity for such use in slack times.

**B. Industrial, Trade and Commercial Organizations:** The power of business units is multiplied and their leadership is strengthened by vigorous, intelligent and far-sighted trade organizations. Through them it is possible to carry the foregoing principles into action on an industry-wide basis, which is necessary to their realization in each industry as a whole and to the even balance among all industries requisite to stable progress. They should cooperate in:

(1) Collection of data on costs, stocks, production, potential productive capacity and market conditions.

(2) Interchange of credit information.

(3) Development of codes of practice.

(4) Establishment of standards of employment salaries and wages within the industry.

(5) Development of opportunities for stabilizing business.

(6) Study of market development.

(7) Economic development and use of natural resources.

# A CHECK SHEET of Practical Suggestions for Planning a Company Program

## I—Long Term Planning of Business Operations

**A.** Definitely abandon the yearly period as the basis for business operations, except in accounting matters.

(1) Project business policies and planning, wherever possible, upon a three-year period or longer as a unit.

**B.** Initiate research from the customer's standpoint to determine:

**Analyzing the Business**

(1) To what extent established lines should be replaced, improved or simplified.
(2) What additional markets can profitably be penetrated with these lines.
(3) What new products can logically be added for present and new markets.

Appropriations made for this research should be distributed over a long enough period to carry the project through without interruptions. (Some companies charge such appropriations to capital

(3) A policy for 1931 expenditures.

## II—Coordination with Industry or Trade

**A.** The success of long term planning for an individual business is multiplied and secured when similar policies are established throughout the industry.

(1) Aid in the establishment and share in the active development of an industry, trade or commercial organization —

(a) to collect data on costs, stocks, production, potential productive capacity and market conditions.

(b) to interchange credit information.

(c) to develop codes of practice.

(d) to take full advantage of legal trade cooperation.

(2) Cooperate to establish standards of employment, salaries and wages within your industry. (Labor is particularly susceptible to advantages offered by a business where long-term planning gives stable employment.)

## III—Promotion of National Prosperity

**A.** The net profits of a modern business depend not only on its own activities but on sustained business stability throughout the country. There is a vital responsibility upon each business enterprise to do its share to provide national stability of purchasing power through —

**Stabilization of National Purchasing Power**

(1) A policy for employment.

(a) Establish a minimum payroll based on the planned program of production and sales and consider this minimum payroll as a fixed charge on the business. (*Example*—the Procter & Gamble plan.)

(b) Maintain a salary and wage scale that permits a high standard of living and thus of purchasing power.

(c) In slack periods, preserve the organization of trained personnel by reducing hours of work per man rather than reducing number of employees.

(d) Set up a reserve to protect the security of employment in times of reduced production.

(2) A policy for dividends.

(a) Resist the temptation to pay out excessive sums in dividends in boom times. Rather place excess earnings in reserve and do not hesitate to use this reserve in slack times to maintain national purchasing power through dividend disbursements. (*Example*—U. S. Steel Corp. policy.)

(3) A policy for 1931 expenditures.

Business cannot return to normal until there is put into circulation for one year an additional amount of money [illegible] modernization, research for development, new patents, etc.

the project through without interruptions. (Some companies charge such appropriations to capital

**C. Banking and Financial Institutions:** Next to the will and intelligence of individual and organized business, the most important factor in achieving the four objectives of this platform is the understanding and cooperation of the banking system in checking excessive inflation in times of prosperity and excessive deflation in times of depression. In the exercise of this function, business itself may well expect banking and financial institutions to:

(1) Require business management to think in terms of long-time planning where financial assistance is provided.
(2) Encourage corporations to accumulate substantial reserves in good times to be used in slack times for development and dividends.
(3) Discourage the extension of excessive credit in periods of unusual prosperity and in like measure facilitate legitimate credit in times of stringency.
(4) Assist in the promotion of mergers where real benefits can be obtained but oppose the merging of corporations for stock selling purposes.
(5) Lead in the development of international financial cooperation.

**D. Labor:** Stability of industrial and business operations requires a sympathy by American workers with the policies expressed in this platform, and a willingness to cooperate in making them effective. Responsibility rests upon labor as well as upon management if the worker is to enjoy the benefits of our business system. To this end labor should actively support these principles:

(1) That increased wages are dependent upon increased efficiencies in production and distribution.
(2) That business must be conducted profitably if labor is to enjoy higher standards of living.
(3) That employers operating on a program of long-time planning provide the maximum stability of employment.
(4) That labor should demand of their leaders an understanding of sound business principles.
(5) That the welfare of labor will best be served by recourse to arbitration and the avoidance of industrial strife.
(6) That the development of international trade is essential to domestic prosperity.
(7) That the extension of governmental activity hampers business in assuming its social responsibilities.

**E. Government:** The essential function of government is to keep clear the field of economic activity for private business initiative and to assure a basis of fair and equal competition. It can best promote sound economic development through these policies:

(1) Refrain from competing with any kind of business itself.
(2) Encourage the development of the necessary control of business through self-government rather than by legislation.
(3) Safeguard the economic stability of the country by maintaining stability in its own fiscal and international policies
(4) Exercise the greatest economy in public expenditures.
(5) Reduce to a minimum the number of laws affecting business.
(6) Cooperate with foreign nations for the fullest development of international trade.

## AND IN CONCLUSION

THESE RECOMMENDATIONS can have value only as they are applied in the planning of individual company operations and in the programs of those industrial, commercial, financial and governmental agencies that are responsible for the conduct of our economic affairs. But taken broadly they constitute a platform of economic principles and business policies upon which far sighted management may well make a stand.

New conditions of our modern industrial civilization have laid new social responsibilities upon those men who guide the destinies of business enterprise. The protection of the welfare of workers and their security of employment and the assurance of permanent income to investors have become basic factors in the attitude of public opinion towards industry. And public opinion in the end has the power to preserve or to curtail that freedom of initiative around which the whole philosophy of American life has been organized.

Business management must meet the call of these responsibilities, therefore, if the people of the world are to be lifted out of the present depression and given assurance of greater stability of earning power in the future. Business leadership itself must strengthen and secure the success of this system of private initiative and cooperative effort upon which the prosperity of this country has been founded and of which it stands today as practically the sole exponent.

This proposed platform is being presented to American business through McGraw-Hill publications reaching into nearly every major industry in the country. It will be developed and interpreted editorially as a guide to the formulation of individual plans and business policies.

AS A FURTHER AID in that direction the reader will find within this supplement a check sheet of practical suggestions. Many of them are known to be practised by successful, well managed business concerns. It is believed that they will be of value and assistance to all American businessmen in planning for future progress and prosperity.